

CALL I

Project title: Molecular Basis of Insect-Plant Interactions in Rice

Project Code : 1001
Duration of the project : December 2006 – March 2012
PI Name : Dr. J.S. Bentur
CCPI Name : Dr. J. Nagaraju
Lead Centre : ICAR-IIRR, Hyderabad
Cooperating centre : CDFD, Hyderabad

Objectives:

- To identify plant genes that are up or/ and down regulated in the susceptible rice variety (Jaya or TN1) upon gall midge biotype 1 infestation
- To identify plant genes that are up or/ and down regulated in the resistant rice variety (Phalguni) carrying gall midge resistance gene (*Gm2*) upon infestation with the avirulent gall midge biotype 1. This interaction is characterized by expression of hypersensitive reaction (HR)
- To identify plant genes that are up or/and down regulated in rice resistant rice variety (Kavya) carrying gall midge resistance gene (*Gm1*) upon infestation with the avirulent gall midge biotype 1. This interaction is characteristic of not involving HR
- To identify plant genes that are up or/ and down regulated in rice variety Phalguni upon infestation with gall midge biotype 4 which carries virulence gene (vGm2)
- To identify gall midge genes in the salivary gland and mid-gut tissues of biotypes 1 and 4 that are up or/and down regulated upon feeding of the rice varieties Jaya/TN1, Phalguni and Kavya

Achievements:

- Developed critical genomic resources such as an EST database and virulence-specific molecular markers for the rice gall midge
- Uncovered key defence pathways and gene regulation mechanisms in diverse rice genotypes, collectively advancing molecular understanding of insect–plant interactions and supporting the development of pest-resistant rice varieties.

Project title: Targeted gene integration in rice and cotton

Project Code : 1002
Duration of the project : December 2006 – March 2012
PI Name : Dr. P. Anand Kumar
CCPI Names : Prof. S.K. Sen
: Dr. I.S. Katageri
Lead Centre : ICAR-NRCPB, New Delhi
Cooperating centres : IIT, Kharagpur
: UAS, Dharwad

Objectives:

- To clone genes from cotton which can facilitate homologous recombination
- To generate vector constructs for gene targeting in rice based on *cre-lox* strategy.
- To clone zinc finger proteins from cotton and design Zinc Finger Nucleases.
- Construction of gene targeting vectors for genetic transformation of rice and cotton (based on *cre-lox* and custom-designed ZFNs, respectively).
- Genetic transformation of rice and cotton, molecular analysis of the transgenic plants and agronomic evaluation

Achievements:

- Successfully developed the marker-free transgenics plants with advanced gene integration techniques, enabling precise targeting of foreign genes, significantly improving transgene expression, reducing transformation time and cost, and enhancing efficiency in selecting high-performing transgenic lines with novel traits.

Project title: Transcriptional level of developmentally important genes in buffalo pre implantation embryos

Project Code : 1003
Duration of the project : December 2006 – March 2012
PI Name : Dr. G. Taru Sharma
CCPI Names : Dr. A. Palanisamy
: Dr. Shiv Prasad
Lead Centre : ICAR-IVRI Izatnagar
Cooperating centres : Madras Veterinary College TANUVAS
: GBPUA&T, Pantnagar

Objectives:

- The major objective of this work is to find out temporal pattern of expression (quantitative and qualitative both) of a set of developmentally important gene transcripts characterising several physiological compartments in the *in vitro* developed and *in vivo* generated buffalo embryos of different stages (2 cell to blastocyst stage)
- Transcriptional pattern of the following ten genes involved in the physiological processes would be determined in the buffalo preimplantation embryos, which will be generated *in vitro* under semi defined culture conditions and produced *in vivo*

Achievements:

a) Publications:

- Sharma GT, Nath A, Prasad S, Singhal S, Chandra V, Saikumar G (2020) Expression pattern of GLUT 1, 5, 8 and citrate synthase transcripts in buffalo (*Bubalus bubalis*) preimplantation embryos produced *in vitro* and derived *in vivo*. *Reproduction in Domestic Animals*. 55:1362-1370. <https://doi.org/10.1111/rda.13782>.
- Sharma GT, Prasad S, Nath A, Singhal S, Singh N, Gade NE, Sai GK (2012) Expression and characterization of constitutive heat shock protein 70.1 (hspa-1a) gene in *in vitro* produced and *in vivo* derived buffalo (*Bubalus bubalis*) embryos. *Reproduction in Domestic Animal*. doi: 10.1111/j.1439-0531.2012. 02002.x).
- Eswari S, Sai GK, Sharma GT (2012) Expression of mRNA encoding Leukaemia inhibitory factor (LIF) and its receptor (LIFR β) in buffalo preimplantation embryos produced *in vitro*: markers of successful embryo implantation. *Zygote*. doi: 10.1017/S0967199412000172.
- Chandra V, Sai GK, Sharma GT (2011) Temporal Expression pattern of Insulin-like growth factors (IGF-I and IGF-2) ligands and their receptors (IGF-1R and IGF-2R) in buffalo (*Bubalus bubalis*) embryos produced *in vitro*. *Livestock Science*. 135:225–230.
- Eswari S, Rajarajan K, Sai GK, Sharma GT (2011) Supplementation of Leukaemia Inhibitory Factor on *in vitro* development of buffalo embryos. *Tamil Nadu Journal of Animal Science* 6(6): 255-261.

- Eswari S, Sai GK, Sharma GT (2011) Expression of messenger RNA encoding LIF receptor beta in buffalo pre-implantation embryos produced *in vitro*. Indian Journal of Animal Sciences. 81:12-14.
- Sharma GT, Dubey PK, Sai GK (2011) Localization and expression of follicle-stimulating hormone receptor in buffalo preantral follicles. Reproduction in Domestic Animal. 46:114–120. doi: 10.1111/j.1439-0531.2010. 01604.x
- Sharma GT, Dubey PK, Nath A, Sai GK (2011) Localization and expression of proliferating cell nuclear antigen (PCNA) and cyclin B1 in buffalo (*Bubalus bubalis*) ovary during different stages of follicular development. Indian Journal of Animal Sciences. 81 (3):231–234.
- Mishra A, Chandra V, Sharma G Taru (2010) Effect of epidermal growth factor on *in vitro* maturation of buffalo oocytes and subsequent development with insulin-like growth factor-1 and β -mercaptoethanol. Indian Journal of Animal Sciences. 80 (8):1
- Mishra A, Sharma GT (2010) Quantification of mRNA in buffalo (*Bubalus bubalis*) oocytes and different stages of developing embryos produced *in vitro*. Indian Journal of Animal Sciences. 80(2):121-122.
- Rajhans R, Sai GK, Dubey PK, Sharma GT (2010) Effect of timing of development on total cell number and expression profile of HSP 70.1 and GLUT1 in buffalo (*Bubalus bubalis*) pre-implantation embryo produced *in vitro*. Cell Biology International. 34:463-468.
- Sharma GT, Dubey PK, Chandra V (2010) Morphological changes, DNA damage and embryonic developmental competence of *in vitro* matured, vitrified-thawed buffalo (*Bubalus bubalis*) oocytes: A comparative study of two cryoprotectants and two cryodevices. Cryobiology. 60:315-321. doi: 10.1016/j.cryobiol.2010.02.006.
- Mishra A, Sai GK, Sharma GT (2009) Expression of Cx43 and PAP genes in vitrified *in vitro* matured buffalo oocytes. Indian Journal of Animal Physiology. 4(1):6-10.
- Mishra AK, Sharma GT (2009) *In vitro* culture of buffalo embryos using insulin like growth factor-1 (IGF-1) in modified synthetic oviductal fluid and TC-199. Indian Journal of Animal Physiology. 4(1):15-18.
- Rajhans R, Sai GK, Chandra V, Mishra A, Sharma, GT (2009) Total RNA content in buffalo (*Bubalus bubalis*) oocytes and different stages of pre-implantation embryos produced *in vitro*. Indian Journal of Animal Sciences. 79 (10):1004-1006.
- Sharma GT, Loganathasamy K (2007) Effect of meiotic stages during *in vitro* maturation on the survival of vitrified- thawed buffalo oocytes. Veterinary Research Communication. 31 (7):881-893.

b) Patent:

- Buffalo embryonic stem cell derived teratomas for the assessment of pluripotency (Patent File no. 2454/DEL/2010)

Project title: Application of reverse genetics: a novel approach for studying the molecular basis of immune response in Indian cattle breed

Project Code : 1004
Duration of the project : December 2006 – November 2011
PI Name : Dr. V.V.S. Suryanarayana
CCPI Names : Prof. M.S. Shaila
: Dr. M.K. Rao
Lead Centre : ICAR-IVRI, Bangalore
Cooperating centres : IISc, Bangalore
: ICAR-NDRI, Bangalore

Objectives:

- Construction of chimeric infective cDNA carrying structural protein genes of FMDV serotypes O and A in separate constructs with the Asia 1 backbone
- Production of inactivated virus vaccines with chimeric viruses
- Carryout vaccination studies in guinea pig model first and subsequently in identified cattle breeds
- Study the variation in immune response in different cattle breeds and against different serotypes
- Development of a marker vaccine and study its application

Achievements:

a) Publications:

- Saravanan T, Kumar CA, Reddy GR, Dechamma HJ, Nagarajan G, Ravikumar P, Srinivas G (2011) Construction of genome-length cDNA for foot-and-mouth disease virus serotype Asia 1 IND 63/72 vaccine strain. International Journal for Biotechnology and Molecular Biology Research. 2(2):39-45.
- Chockalingam AK, Thiyagarajan S, Govindasamy N, Patnaikuni R, Garlapati S, Golla R, Joyappa R, Krishnamshetty DH, Suryanarayana VVS (2010) Study of a chimeric foot-and-mouth disease virus DNA vaccine containing structural genes of serotype O in a genome backbone of serotype Asia 1 in guinea pigs. Acta Virology. 54(3):189-95.

b) Patent:

- A novel foot and mouth disease virus Asia1 (Indian vaccine strain) replicon based viral vector for vaccine research and development (Patent File no. 3807/DEL/2011)

Project title: Gene-based genetic maps and molecular markers for biotic and abiotic stress tolerance in cultivated groundnut

Project Code : 1005
Duration of the project : December 2006 - November 2011
PI Name : Dr. R.K. Varshney
CCPI Names : Dr. T. Radhakrishnan
: Dr. M.V.C. Gowda
Lead Centre : ICRISAT, Hyderabad
Cooperating centres : ICAR-NRCG, Junagarh
: UAS, Dharwad

Objectives:

- Generation of microsatellite-enriched libraries and identification of ~500 microsatellite or simple sequence repeat (SSRs) loci
- Generation of groundnut unigene-derived SNP markers and development of cost-effective CAPS assay
- Construction of integrated genetic maps with SSR, SNP and DArT (to be generated under *Centre of Excellence* project of DBT) markers
- Phenotyping of mapping populations at three locations (ICRISAT, NRCG, UAS) over 3 years
- Identification of genes/QTLs associated with resistance to foliar diseases (rust and late leaf spot) and tolerance to drought (SCMR and SLA)

Achievements:

a) Publications:

- Gautami B, Pandey MK, Vadez V, Nigam SN, Ratnakumar P, Krishnamurthy L, Radhakrishnan T, Gowda MVC, Narasu ML, Hoisington DA, Knapp SJ, Varshney RK (2012) Quantitative trait locus analysis and construction of consensus genetic map for drought tolerance traits based on three recombinant inbred line populations in cultivated groundnut (*Arachis hypogaea* L.). *Molecular Breeding*. 30 (2):757-772. doi: 10.1007/s11032-011-9660-0.
- Pandey MK, Gautami B, Jayakumar T, Sriswathi M, Upadhyaya HD, Gowda MVC, Radhakrishnan T, Bertoli DJ, Knapp SJ, Cook DR, Varshney RK (2012) Highly informative genic and genomic SSR markers to facilitate molecular breeding in cultivated groundnut (*Arachis hypogaea* L.). *Plant Breeding*. 131:139–147. doi:10.1111/j.1439-0523.2011.01911.x.
- Pandey MK, Monyo E, Ozias AP, Liang X, Guimarães P, Nigam SN, Upadhyaya HD, Janila P, Zhang X, Guo B, Cook DR, Bertoli DJ, Michelmore R, Varshney RK (2012)

Advances in *Arachis* genomics for peanut improvement. *Biotechnology Advances*. 30(3):639–651. <https://doi.org/10.1016/j.biotechadv.2011.11.001>.

- Sujay V, Gowda MVC, Pandey MK, Bhat RS, Khedikar YP, Nadaf HL, Gautami B, Sarvamangala C, Lingaraju S, Radhakrishnan T, Knapp SJ, Varshney RK (2012) Quantitative trait locus analysis and construction of consensus genetic map for foliar disease resistance based on two recombinant inbred line populations in cultivated groundnut (*Arachis hypogaea* L.). *Molecular Breeding*. 30 (2):773-788. doi: 10.1007/s11032-011-9661-z.
- Khedikar YP, Gowda MVC, Sarvamangala C, Patgar KV, Upadhyaya HD, Varshney RK (2010) A QTL study on late leaf spot and rust revealed one major QTL for molecular breeding for rust resistance in groundnut (*Arachis hypogaea* L.). *Theoretical and Applied Genetics* 121:71 984. doi: 10.1007/s00122-010-1366-x.
- Cuc LM, Mace ES, Crouch JH, Quang VD, Long TD, Varshney RK (2008) Isolation and characterization of novel microsatellite markers and their application for diversity assessment in cultivated groundnut (*Arachis hypogaea*). *BMC Plant Biology*. 8:55–65.
- Cuc LM, Mace ES, Crouch JH, Quang VD, Long TD, Varshney RK (2008) Isolation and characterisation of novel microsatellite markers and their application for diversity assessment in cultivated groundnut (*Arachis hypogaea*). *BMC Plant Biology*. 8:55–65.

Project title: Endocrine Profiles and Characterization of Candidate Genes Influencing Prolificacy in Black Bengal Goat

Project Code : 1006
Duration of the project : February 2007 – March 2012
PI Name : Dr. Avijit Haldar
CCPI Names : Dr. Abhijit Mitra
: Dr. Chanchal kanti Biswas
: Dr. S Pan
Lead Centre : ICAR, Tripura
Cooperating centres : ICAR-IVRI, Izatnagar
: BCKV, Mohanpur
: WBUAFS, Kolkata

Objectives:

- To characterize phenotypically for variation in kidding size in Black Bengal goats
- To investigate the ovulation rate with observed variation in kidding size
- To elucidate the endocrine profiles for variation in kidding size
- To clone and characterize the candidate genes (viz. BMPs and BMPRs) that are known to influence the fecundity
- To study the polymorphism and differential expression of the candidate genes and their association with variation in prolificacy in Black Bengal goat

Achievements:

a) Publications:

- Haldar A, Pal P, Datta M, Paul R, Pal SK, Majumdar D, Biswas, CK, Pan S (2014) Prolificacy and its relationship with age, body weight, parity, previous litter size and body linear type traits in meat-type goats. Asian- Australian Journal of Animal Sciences. 27(5):628- 634. doi: 10.5713/ajas.2013.13658.
- Haldar A, Pal P, Majumdar D, Biswas CK, Ghosh S, Pan S (2014) Body linear traits for identifying prolific goats. Veterinary World. 7(12):1103-1107. doi: 10.14202/vetworld.2014.1103-1107.
- Haldar A, Pal SK, Datta M, Majumdar D, Prakash BS (2014) Plasma micronutrients status and gonadotrophin hormone profiles during peripubertal period in female Black Bengal goat. Indian Journal of Animal Sciences. 84(12):1270–1275.
- Pan S, Biswas CK, Majumdar D, Sengupta D, Patra A, Ghosh S, Haldar A (2014) Influence of age, body weight, parity and morphometric traits on litter size in prolific Black Bengal goats. Journal of Applied Animal Research. doi.org/10.1080/09712119.2014.928623.

- Haldar A, Pal SK, Chakraborty S, Hazorika M, Pan S, Majumdar D, Biswas CK, Patra A, Mirmahmoudi R, Prakash BS (2013) Endocrine markers for identifying prolificacy potential and predicting fetal number in goats. *Animal Reproduction Science*. 140(1-2):54-61. doi: 10.1016/j.anireprosci.2013.05.005.
- Sharma P, Singhi RK, Pal SK, Pan S, Mitra A (2013) Differential Ovarian Morphometry and Follicular Expression of BMP15, GDF9 and BMPRII Influence the Prolificacy in Goat. *Reproduction in Domestic Animals*. 48(5):803-809. doi: 10.1111/rda.12165.

ICAR-NASE

Project title: Antiluteolytic strategies- a novel approach to enhance fertility in buffalo

Project Code : 1007
Duration of the project : February 2007 – January 2012
PI Name : Dr. S.K. Agarwal
CCPI Names : Dr. S. Selvaraju
: Dr. R. Medhamurthy
: Dr. Shiv Prasad
: Dr. G.S. Dhaliwal
Lead Centre : ICAR-IVRI Izatnagar
Cooperating centres : ICAR-NIANP, Bangalore
: IISc, Bangalore
: GBPUAT, Pantnagar
: GADVASU, Ludhiana

Objectives:

- To study the cellular and molecular mechanisms regulating pregnancy recognition and corpus luteum functions in buffalo.
- Antiluteolytic strategies to enhance embryonic survival-fertility in Buffalo

Achievements:

a) Publications:

- Medhamurthy R, Jyotsna UR, Kunal BS, Killivalavan A, Sudeshna T, Ravindra JP (2012) Characterization of seasonal variations in responsiveness of pituitary gland to different doses of gonadotropin releasing hormone in buffalo cows. Journal of Buffalo Science. 1:61-68. DOI: <http://dx.doi.org/10.6000/1927-520X.2012.01.01.11>.
- Jerome A, Singh SK, Agarwal SK (2011) Structural modeling and analysis of Pregnancy Associated Glycoprotein-1 of buffalo (*Bubalus bubalis*) ISRN. Molecular Biology. Article ID 481539, 8 pages. doi.org/10.5402/2012/481539.
- Jerome A, Singh SK, Agarwal SK, Saini M, Raut A (2011) Characterization and in silico analysis of pregnancy associated glycoprotein-1 gene of buffalo (*Bubalus bubalis*). Genetics Research International. doi.org/10.4061/2011/436138.
- Malik AA, Gandotra VK, Brar PS, Ghuman SPS, Dhaliwal GS (2011) Attenuation of luteolytic response following fish meal supplementation in dairy buffaloes (*Bubalus bubalis*). Animal Reproduction Science. 126:45-49.
- Pandey AK, Dhaliwal GS, Ghuman SPS, Agarwal SK (2011) Impact of pre-ovulatory follicle diameter on plasma estradiol, subsequent luteal profiles and conception rate in Buffalo (*Bubalus bubalis*). Animal Reproduction Science. 123(3-4):169-174.
- Lalthazuali, Singh J, Ghuman SPS, Pandey AK, Uppal SK, Ahuja CS Dhaliwal GS (2010) Effect of insulin treatment during post-AI mid-luteal phase on the blood biochemical profile and conception rate in buffaloes. Buffalo Bulletin. 29(4):250-255.

- Rajkumar R, Singh SK, Agarwal SK, Mahmood S, Shankar U (2010) Effect of Selective COX2 Inhibitor on Conception rate, Progesterone and PGFM profile in Buffalo (*Bubalus bubalis*). Journal of Applied Animal Research. 38:209-212. doi.org/10.1080/09712119.2010.10539512.
- Selvaraju S, Raghavendra BS, Subramani TS, Priyadharsini R, Reddy IJ, Ravindra JP (2010) Changes in luteal cells distribution, apoptotic rate, lipid peroxidation levels and antioxidant enzyme activities in buffalo (*Bubalus bubalis*) corpus luteum. Animal Reproduction Science. 120:39-46. doi.org/10.1016/j.anireprosci.2010.02.017.
- Lalthazuali, Singh J, Ghuman SPS, Pandey AK, Dhaliwal GS (2010) Impact of insulin treatment during post-insemination mid-luteal phase on luteal profile and conception rate in buffaloes. Indian Journal of Animal Sciences 80: 854-856.
- Honparkhe M, Ghuman SP, Dadarwal S, Singh DJ, Dhaliwal GS (2009) Embryonic mortality and luteal profile in buffaloes administered GnRH at the onset of estrus or hCG 5 days after AI. Indian Journal of Animal Sciences. 79 (8):778-780.

Project title: Development of molecular probes for diagnosis of different virulent and anastomosis groups of *Rhizoctonia solani* infecting leguminous crops

Project Code : 1008
Duration of the project : February 2007 – March 2012
PI Name : Dr. S.C. Dubey
CCPI Name : Dr. H.C. Lal
Lead Centre : ICAR-IARI, New Delhi
Cooperating centre : BAU, Ranchi

Objectives:

- To characterize genetic variability in *R. solani* with biological, morphological and molecular markers
- To generate molecular probes/markers for the detection of *R. solani* in infected tissues and soils
- To establish relationship among isolates of *R. solani* and formulate a standard grouping system based on common morphology, anastomosis, virulence and DNA markers

Achievements:

a) Publications:

- Dubey SC, Tripathi A, Upadhyay BK (2011) Molecular diversity analysis of *Rhizoctonia solani* isolates infecting various pulse crops in different agro-ecological regions of India. *Folia Microbiologica*. 57(6):513.
- Dubey SC, Tripathi A, Upadhyay BK, Thakur M (2011) Pathogenic behaviour of leguminous isolates of *Rhizoctonia solani* collected from different Indian agro-ecological regions. *Indian Journal of Agricultural Science*. 81(10):948-53.

Project title: Electro-magnetic energies for biostimulation and post-harvest conservation of seeds, and agri-products

Project Code : 1009
Duration of the project : February 2007 – March 2011
PI Name : Dr. Shantha Nagarajan
CCPI Names : Dr. Amaresh Chandra
: Dr. K.P. Ray
: Dr. K.N. Guruprasad
Lead Centre : ICAR-IARI, New Delhi
Cooperating centres : ICAR-IGFRI, Jhansi
: SAMEER, Mumbai
: DAVV, Indore

Objectives:

- To fabricate MW and RF generators with variable frequencies and pulsed magnetic field
- To overcome dormancy in hard seeded crops and to enhance germination characters and storability in seeds using RF, MW and magnetic fields
- To evaluate efficacy of MW and RF energies in controlling microflora and storage pests in seeds and grains
- To establish a relation between the biochemical and biophysical parameters associated with the germination process of the seeds treated with RF, MW and magnetic field and quality studies in agri-products

Achievements:

a) Publications:

- Anand A, Nagarajan S, Verma APS, Joshi DK, Pathak PC, Bhardwaj J (2012) Pre-treatment of seeds with static magnetic field ameliorates soil water stress in seedlings of maize (*Zea mays* L.). Indian Journal of Biochemistry & Biophysics. 49(1):63-70.
- Bhardwaj J, Anand A, Nagarajan S (2012) Biochemical and biophysical changes associated with magneto priming in germinating cucumber seeds. Plant Physiology and Biochemistry. 57:67-73. doi: 10.1016/j.plaphy.2012.05.008.
- Shine MB, Guruprasad KN, Anand A (2012) Effect of stationary magnetic field strength of 150 and 200 mT on reactive oxygen species production in soybean. Bioelectro magnetics. 33(5):428-37. doi: 10.1002/bem.21702.
- Nagarajan S, Bhardwaj J, Anand A, Pandita VK, Verma APS (2012). Static magnetic field exposure improves germination and vigour of fresh and carry-over seeds of garden pea. Indian Journal of Horticulture. 69(3):435-438.

- Anand A, Bhardwaj J, Nagarajan S (2011) Comparative evaluation of seed coat dormancy breaking treatments in *Stylosanthes seabra*. Grass and Forage Science. doi.org/10.1111/j.1365-2494.2011.00787.x
- Shine MB, Guruprasad KN, Anand A (2011) Enhancement of germination, growth and photosynthesis in soybean by pre-treatment of seeds with a magnetic field. Bioelectromagnetics. doi.org/10.1002/bem.20656.
- Anand A, Nagarajan S, Joshi DK, Verma APS, Kar A (2009). Microwave seed treatment reduces hard seededness in *Stylosanthes seabra* and promotes redistribution of cellular water as studied by NMR relaxation measurements. Seed Science & Technology. 37(1): 88-97. doi:10.15258/sst.2009.37.1.11.
- Vashisth A, Nagarajan S (2009) Characterisation of water binding and germination traits of magnetically exposed maize (*Zea mays* L) seeds equilibrated at different relative humidities at two temperatures. Indian Journal of Biochemistry & Biophysics 46(2):184-91.
- Vashisth A, Nagarajan S (2009) Effect on germination and early growth characteristics in sunflower (*Helianthus annuus*) seeds exposed to static magnetic field. Journal of Plant Physiology. 167(2):149-56.
- Vashisth A, Nagarajan S (2008) Exposure of seeds to static magnetic field enhances germination and early growth characteristics in chickpea (*Cicer arietinum* L). Bioelectromagnetics. 29(7):571-8.
- Baronia C, Chandra A (2007) Changes in biochemical attributes in siratro caused by exposure to microwave energy. Range Management and Agroforestry. 28 (2):251-252.
- Vashisth A, Nagarajan S (2007). Effect of magnetic field on seed performance of diverse crop species. Indian Journal of Agricultural Sciences. 78(8):708-711.
- Vashisth, A. and Nagarajan, S. (2007). Effect of pre-sowing exposure to static magnetic field of maize (*Zea mays* L.) seeds on germination and early growth characteristics. Pusa Agri Science, 30:48-55.

Project title: Rumen microbial manipulations for mitigation of methane emission and productivity enhancement in dairy animals

Project Code : 1010
Duration of the project : February 2007 – January 2012
PI Name : Dr. S.K. Sirohi
CCPI Names : Dr. M. Chandrasekharaiah
: Dr. L.C. Chaudhary
: Dr. A Santra
Lead Centre : ICAR-NDRI, Karnal
Cooperating centres : ICAR-NIANP, Bangalore
: ICAR-IVRI, Izatnagar
: ICAR-NDRI, Kalyani

Objectives:

- Isolation, identification and quantification of the principal methanogens in rumen on different diets.
- Reduction of ruminal hydrogen available for methane production by diverting Hydrogen for increasing energy supply by using rumen modifiers i.e organic acids, plant secondary metabolites and buffers etc.
- Evaluation of the effects of methane reduction on major ruminal microbes and fermentation patterns.
- Evaluating potent methane-inhibiting strategies under in vivo conditions

Achievements:

a) Publications:

- Sharma A, Istamboulie G, Hayat A, Catanante G, Bhand S, Marty JL (2017) Disposable and portable aptamer functionalized impedimetric sensor for detection of kanamycin residue in milk sample. Sensors and Actuators B: Chemical. 245:507-515 <https://doi.org/10.1016/j.snb.2017.02.002>.
- Chandrasekharaiah M, Thulasi A, Bagath M, Prasanna KD, Santosh SS, Lyju JV, Palanivel C, Sampath KT (2012) Isolation, morphological and molecular characterization of novel Methanogenicarchaeaspp. From the rumen of crossbred steers - First report from India. Journal of Applied Zoological Researches. 4:1-9.
- Sirohi SK, Chaudhary PP, Goel N (2012) Supplementation Effect of Myristica fragrans on Methane Production, Rumen fermentation and methanogens population in total mixed diet *in vitro*. Veterinary World. 5(6):335-340.
- Sirohi SK, Mehta M, Goel N, Pandey P (2012) Effect of herbal plants oil addition in total mixed diets on anti-methanogenic activity, rumen fermentation and gas

production kinetics *in vitro*. Journal of Natural Product and Plant Resources 2(1):73-80.

- Chaudhary PP, Sirohi SK, Saxena J (2012) Diversity analysis of methanogens in rumen of *Bubalus bubalis* by 16S riboprinting and sequence analysis. Gene. 493 (1):13–17. doi.org/10.1016/j.gene.2011.11.041
- Chaudhary PP, Sirohi SK, Kumar S (2011). Improved extraction of quality DNA from Methanogenic archaea present in rumen liquor for PCR application. Asian Journal of Animal Sciences. 5:166-277.
- Chaudhary PP, Sirohi SK, Singh D, Saxena J (2011). Methyl coenzyme M reductase (mcrA) gene based phylogenetic analysis of methanogens population in Murrah buffaloes (*Bubalus bubalis*). The Journal of Microbiology 49(4): 558-561.
- Goel N, Sirohi SK, Dwivedi J (2011) Studies on the effects of methanolic extract of *Cinnamomum zeylanicum* on *in-vitro* methane inhibition and rumen fermentation patterns. Journal of Chemical and Pharmaceutical Research. 3 (6): 609-615.
- Goel N, Sirohi SK, Dwivedi J, Chaudhary PP (2011) Efficacy of different plant part combinations as rumen fermentation modulator in wheat straw-based diet evaluated *in vitro*. Annals of Biological Research. 2 (6):91-96.
- Sharma A, Chaudhary PP, Sirohi SK, Saxena J (2011) Structure modeling and inhibitor prediction of NADP oxidoreductase enzyme from *Methanobrevibacter smithii*. Bioinformation. 6:15-19.
- Kumar S, Dagar SS, Mohanty AK, Sirohi SK, Puniya M, Kuhad RC, Sangu KP, Griffith GW, Puniya AK (2011) Enumeration of methanogens with a focus on fluorescence in situ hybridization. Naturwissenschaften. 98(6):457-72.
- Sirohi SK, Pandey N, Singh B, Puniya AK (2010) Rumen methanogens: A Review. Indian Journal of Microbiology. 50:253-262.
- Chaudhary PP, Sirohi SK (2009) Dominance of Methanomicrobium phylotype in rumen (*Bubalus bubalis*) methanogens from India. Letters in Applied Microbiology. 49 (2):274-277.
- Sirohi SK, Pandey N, Goel N, Singh B, Mohini M, Pandey P, Chaudhary PP (2009) Microbial activity and ruminal methanogenesis as affected by plant secondary metabolites in different plant extracts. International Journal of Environmental Science and Engineering. 1:1.
- Thulasi A, Chandrasekharaiah M, Sampath KT (2008) Biodiversity of Methanogenic archaea in the various ecosystems of the environment – A review. Journal of Environmental Sciences. II (1):60-74.

b) Patent:

- Reduction of methane emission (Patent file no. 87/CHE/2012)

Project title: Development of autotransgenic Asian Catfish *Clarias batrachus* L .

Project Code : 1011
Duration of the project : February 2007 – January 2012
PI Name : Dr. K.C. Majumdar
CCPI Name : Dr. G. Vanugopal
Lead Centre : CCMB, Hyderabad
Cooperating centre : ICAR-CIFE, Mumbai

Objectives:

- Autotransgenes and their functional analysis.
- Gene delivery to obtain autotransgenic fish.
- Development of homozygous autotransgenic *C.batrachus*
- Expression of autotransgene by Northern in transgenic fish.

Achievements:

- Successfully generated and functionally validated autotransgene constructs in *Clarias batrachus* using species-specific promoters (Histone 3 and β -actin), growth hormone gene components.
- Recombinant GH protein was produced and used to generate polyclonal antibodies for transgene detection; putative transgenic individuals were raised to maturity, and initial crosses have been established for further evaluation of growth performance.

**Project title: Induction of apomixis in sorghum by down-regulation of
“somatic –embryogenesis-receptor-kinase**

Project Code : 1012
Duration of the project : February 2007 – January 2012
PI Name : Dr. B. Venkatesh Bhat
CCPI Names : Dr. Imran Siddique
: Dr. Vishnu Bhat
Lead Centre : NRCS, Hyderabad
Cooperating centres : CCMB, Hyderabad
: DU, Delhi

Objectives:

- Isolation and characterization of SERK gene in sorghum
- Isolation of ovule specific promoter from sorghum or other species and the analysis of its expression in sorghum
- Development of transgenic sorghum plants with reduced expression of SERK gene in ovules using RNA interference.
- Analysis of elements of apomixis induced and seed development in the SERK-down regulated transgenic plants

Achievements:

- Pandey AK, Ramya S, Madhu P, Bhat VB, Bhat V, Seetharama N (2008), Somatic Embryogenesis Receptor Kinase (SERK) genes in Sorghum (*Sorghum bicolor* L.). Presented at the National Symposium on New Biology in Agriculture at Panjab University, Chandigarh, 7-8 November, 2008.
- Madhu P, Pandey AK, Bhat VB, Bhat V (2015). Identification of somatic embryogenesis receptors (SERK) genes in sorghum through in silico analysis. International Journal of Current Research 8(7): 19362-19367.

Project title: Isolation and characterization of defense peptides from rice and mustard

Project Code : 1013
Duration of the project : February 2007 – January 2012
PI Name : Dr. R.C. Bhattacharya
CCPI Name : Dr. Prem Dureja
Lead Centre : ICAR-NRCPB, New Delhi
Cooperating centre : ICAR-IARI, New Delhi

Objectives:

- To isolate signal peptides related to insect defence from Indian mustard
- To understand the roles of the signal peptides, in systemic wound signaling against mustard aphids (*Lipaphis erysimi*)

Achievements:

a) Publications:

- Bhatia V, Uniyal PL, Bhattacharya RC (2011) Aphid resistance in Brassica crops: Challenges, biotechnological progress and emerging possibilities. *Biotechnology Advances*. 29:879-888. DOI: 10.1016/j.biotechadv.2011.07.005.

b) Patent:

- A peptide elicitor of NPR1 and PR proteins mediated pathogen defence in Indian mustard (*Brassica juncea* L.) (Patent file no.1208/DEL/2011).

Project title: Evaluating candidate genes towards enhancement of drought tolerance in chickpea (*Cicer arietinum*)

Project Code : 1014
Duration of the project : February 2007 – January 2012
PI Name : Dr. Srinivasan
CCPI Names : Dr. R.K. Varshney
: Dr. Jitendra Kumar
: Dr. Rajendra Kumar
Lead Centre : ICAR-NRCPB, New Delhi
Cooperating centres : ICRISAT, Hyderabad
: ICAR-IARI, New Delhi
: SVBPUAT, Meerut

Objectives:

- Generation of drought-responsive expressed sequence tags (ESTs)
- Genetic mapping of ESTs and SSRs into three mapping populations
- Identification of drought tolerance-related root trait QTLs and most responsive candidate genes.
- Expression profiling of candidate genes in the mapping population
- Generation of TILLING population and ascertaining the function of candidate genes

Achievements:

a) Publications:

- Deokar AA, Kondawar V, Jain PK, Karuppayil SM, Raju NL, Vadez V, Varshney RK, Srinivasan R (2011) Comparative analysis of expressed sequence tags (ESTs) between drought-tolerant and -susceptible genotypes of chickpea under terminal drought stress. BMC Plant Biology. 11:70.
- Hiremath PJ, Farmer A, Cannon SB, Woodward J, Kudapa H, Tuteja R, Kumar A, Prakash B, Mulaosmanovic B, Gujaria N, Krishnamurthy L, Gaur P, Kavikishor PB, Shah T, Srinivasan R, Lohse M, Xiao Y, Town CD, Cook D, May GD, Varshney RK (2011) Large-scale transcriptome analysis in chickpea (*Cicer arietinum* L.) an orphan legume crop of the semi-arid tropics of Asia and Africa. Plant Biotechnology Journal. 9:922–993. doi: 10.1111/j.1467-7652.2011.00625. x.
- Nayak S, Zhu H, Varghese N, Choi HK, Datta S, Horres R, Jüngling R, Singh J, Kavikishor PB, Kahl G, Winter P, Cook DR, Varshney RK (2010) Integration of novel SSR and gene-based marker loci in the chickpea genetic map and establishment of new anchor points with *Medicago truncatula* genome. Theoretical and Applied Genetics. 120:1415-1441. doi: 10.1007/s00122-010-1265-1.

Project title: Increasing Nutrient Availability from Roughage-Based Rations Through Enhancing Rumen Efficiency or Reducing Enteric Methane Production by Use of Secondary Plant Metabolites

Project Code : 1015
Duration of the project : December 2007 – January 2012
PI Name : Dr. Ramesh C. Jakhmola
CCPI Names : Dr. M.K. Tripathi
: Dr. Tribhuvan Sharma
Lead Centre : ICAR-CSWRI- Arid Region Campus, Bikaner
Cooperating centres : ICAR-CSWRI- Avikanagar (Raj)
: Rajasthan Agricultural University, Bikaner

Objectives:

- Screening of different plants and their component for their antiprotozoal, anti-methanogenic and fibre degradation stimulating properties
- To study the effects of selected plant extracts with secondary metabolites on nutrient utilisation in ruminants
- Development of protocols for the incorporation of such plant secondary metabolites in the animal diet for enhancing productivity

Achievements:

a) Publications:

- Pal K, Patra AK, Sahoo A, Mandala GP (2014) Effect of nitrate and fumarate in *Prosopis cineraria* and *Ailanthus excelsa* leaves-based diets on methane production and rumen fermentation. *Small Ruminant Research*. 121(2-3): 168-174. <https://doi.org/10.1016/j.smallrumres.2014.08.004>.
- Pal K, Patra AK, Sahoo A, Soren NM (2015) Effects of nitrate and fumarate in tree leaves-based diets on nutrient utilisation, rumen fermentation, microbial protein supply and blood profiles in sheep. *Livestock Science*. 172:5-15. <https://doi.org/10.1016/j.livsci.2014.12.008>.
- Jakhmola RC, Raghuvasi SKS, Pahuja T (2012) Gas Production and Fermentation of *Lasiurus indicus* Based Composite Diet with *Acacia Jacquemontii* leaves. *Indian Journal of Small Ruminants* 18 (1):69-74.

b) Patent:

- Fermentation vessel for conducting gas production studies (*in vitro*: Fabrication, protocol and uses) (Patent file no.2486/DEL/2009).

Project title: Molecular Diagnosis of Fungal Diseases of Cassava, Taro, Amorphophallus and Yam.

Project Code : 1016
Duration of the project : December 2007 – January 2012
PI Name : Dr. (Mrs). M. L. Jeeva
Lead Centre : ICAR-CTCRI, Thiruvananthapuram

Objectives:

- To find an efficient method of purification of DNA from propagules (in soil/ planting material) of *Phytophthora palmivora* var *palmivora* causing cassava tuber rot, *Phytophthora colocasiae* causing taro blight, *Sclerotium rolfsii* causing *Amorphophallus* collar rot and *Colletotrichum gloeosporioides* causing anthracnose /die-back in yams
- To design pathogen specific primers for *Phytophthora palmivora* var *palmivora* causing cassava tuber rot, *Phytophthora colocasiae* causing taro blight, *Sclerotium rolfsii* causing *Amorphophallus* collar rot and *Colletotrichum gloeosporioides* causing anthracnose /die-back in yams
- To standardise the serological detection techniques for *Phytophthora palmivora* var *palmivora* causing cassava tuber rot, *Phytophthora colocasiae* causing taro blight, *Sclerotium rolfsii* causing *Amorphophallus* collar rot and *Colletotrichum gloeosporioides* causing anthracnose /die-back in yams
- To develop an efficient diagnostic test for the detection of the *Phytophthora palmivora* var *palmivora* causing cassava tuber rot, *Phytophthora colocasiae* causing taro blight, *Sclerotium rolfsii* causing *Amorphophallus* collar rot and *Colletotrichum gloeosporioides* causing anthracnose /die-back in yams in soil/ planting material

Achievements:

a) Publications:

- Mithun R, Hegde V, Jeeva ML, Archana PV, Vidyadharan P, Nath VS, Senthil M (2012) Rapid and Efficient Method for the Extraction of Genomic DNA from *Colletotrichum* spp. Suitable for PCR Analysis. *Dynamic Biochemistry, Process Biotechnology and Molecular Biology*. 6(2):95-97.
- Mithun R, Jeeva ML, Hegde V, Vidyadharan P, Archana PV, Senthilalias SM, Nath VS (2012) Polymerase Chain Reaction Assay for Rapid, Sensitive Detection, and Identification of *Colletotrichum gloeosporioides* causing Greater Yam Anthracnose. *Molecular Biotechnology*. 52(3). DOI: 10.1007/s12033-012-9496-9.
- Misra RS, Mishra AK, Jeeva ML, Hegde V (2011) Characterization of *Phytophthora colocasiae* isolates associated to leaf blight of taro in India. *Archives of Phytopathology and Plant Protection*. 44 (6):581-59. <https://doi.org/10.1080/03235400903266339>.

- Azim T, Jeeva ML, Pravi V, Archana PV, Mishra AK (2010) Exploration of Smaller Subunit Ribosomal DNA for Detection of *Colletotrichum gloeosporioides* causing anthracnose in *Dioscorea alata* L. Journal of Root Crops. 36 (1):83-87.
- Jeeva ML, Mishra AK, Vidyadharan P, Misra RS, Hegde V (2010) A species-specific polymerase chain reaction assay for rapid and sensitive detection of *Sclerotium rolfsii*. Australasian Plant Pathology. 39:517–523.
- Mishra AK, Jeeva ML, Vidyadharan P, Misra RS, Hegde V (2010) Rapid and sensitive detection of *Phytophthora colocasiae* associated with leaf blight of taro by species specific polymerase chain reaction assay. Annals of Microbiol. 60 (2):209-215.
- Jeeva ML, Sharma K, Mishra AK, Misra RS (2010) Rapid extraction of genomic DNA from *Sclerotium rolfsii* causing collar rot of *Amorphophallus*. Gene, Genomes and Genomics. 2(1): 60-62.
- Mithun R, Jeeva ML, Pravi V, Archana PV, Mishra AK (2009) Cloning and amplification of smaller subunit ribosomal DNA of *Sclerotium rolfsii* causing collar and tuber rot in *Amorphophallus*. Journal of Root Crops. 35 (2): 206-210.

Project title: Epidemiology and Forewarning System of Downey Mildew Disease of Cucurbits to Develop Appropriate IPM Strategy

Project Code : 1017
Duration of the project : December 2007 – January 2012
PI Name : Dr. Indrabrata Bhattacharya
CCPI Name : Dr. S. Kumar
Lead Centre : BCKV, Mohanpur, West Bengal
Cooperating centre : HARP, ICAR Research Complex for the Eastern Region, Ranchi

Objectives:

- Monitoring the year-round population dynamics of pathogen to assess the inoculum load responsible for the outbreak of the disease
- To study the behaviour of the pathogen under controlled environment with different combinations of weather regimes and crop growth stages
- Climatological studies within the crop canopy to identify the combination of thermal and moisture regime congenial for the occurrence and spread of the disease
- Development of disease forecasting models as a decision support system for Integrated Pest Management

Achievements:

a) Publications:

- Hembram, S., Dutta, S., Bhattacharya, I., Saha, A., Chattopadhyay, A and Majumder, D. (2014). Pathogenic variability of *Pseudoperonospora cubensis* in Gangetic alluvial region of West Bengal, India. Archives of Phytopathology and Plant Protection. DOI: [10.1080/03235408.2013.807567](https://doi.org/10.1080/03235408.2013.807567)

Project title: Molecular Analysis of Agrocin Producing *Agrobacterium radiobacter* for Biological Control of Crown Gall in Stone Fruits

Project Code : 1018
Duration of the project : December 2007 – January 2012
PI Name : Dr. A. K. Gupta
CCPI Names : Prof. Rup Lal
: Dr. K.P. Singh
Lead Centre : Dr.YSPUH&F, Nauni, Solan (H.P.)
Cooperating centres : University of Delhi
: GBPUA&T, Hill Campus, Ranichauri

Objectives:

- Isolation, Identification and evaluation of resident agrocin-producing strains of *Agrobacterium radiobacter* for biological control of crown gall in stone fruit nurseries
- To study the behaviour of non-pathogenic *Agrobacterium radiobacter* acquiring tumour inducing principle (TIP) and dynamics of agrocin-producing strains in the soil after inoculation of the seed
- Development of non-radioactive specific probe of Indian isolate of agrocin-producing *A. radiobacter* strain(s) for rapid detection and selection of superior strain(s) among the populations of pathogenic and non-pathogenic strains of *A. tumefaciens* and testing the efficacy of selected isolates for biological control of crown gall in stone fruit nurseries

Achievements:

b) Publications:

- Gupta AK, Sharma A, Singh D, Chandel S, Sharma RC, Mahajan R, Gupta A (2015) Occurrence of crown gall caused by *Agrobacterium tumefaciens* on rose. Indian Phytopathology. 68 (1):2-6.
- Dua A, Sangwan N, Kaur J, Saxena A, Kohli P, Gupta AK, Lal R (2013) Draft genome sequence of *Agrobacterium* sp. Strain UHFBA-218 isolated from the rhizosphere soil of crown gall-infected cherry rootstock Colt. Microbiology Genome Announcements. doi: 10.1128/genomeA.00302-13.
- Gupta A, Gupta AK, Mahajan R, Singh D, Khosla K, Lal R, Gupta V (2012) Protocol for isolation and identification of *Agrobacterium* isolates from stone fruit plants and sensitivity of native *A. tumefaciens* isolates against agrocin produced by *A. radiobacter* strain K84. National Academy Science Letters. 36(1):79-84. doi: 10.1007/s40009-012-0094-y.
- Gupta AK, Khosla K, Bhardwaj SS, Thakur A, Devi S, Jarial RS, Sharma C, Singh KP, Srivastava DK and Lal R (2009) Biological control of crown gall on peach and cherry rootstock Colt by native *Agrobacterium radiobacter* isolates. Bentham Open Horticulture Journal. 3: 1-10. DOI: 10.2174/1874840601003010001

Project title: Evaluation Of Groundnut Germplasm for Morphological, Physiological and Molecular Characters/traits Associated with Drought Tolerance for Enhancing Productivity in Rain-Dependent System

Project Code : 1019
Duration of the project : December 2007 – January 2012
PI Name : Dr P.C. Nautiyal
CCPI Name : Dr. M.S. Sheshshayee
Lead Centre : ICAR-NRCG, Junagadh, Gujarat
Cooperating centre : UAS, Bangalore

Objectives:

- To study the genetic variability and identify potential traits related to major abiotic stresses (drought, low and high temperatures) in core germplasm group, to identify suitable genotypes for rain-dependent system in the country
- To study genetic diversity in crop canopy and root architecture and function, and to integrate the genetic and physiological performance of groundnut genotypes to identify traits associated with efficient radiation and net water uptake under drought like situations
- To understand the cross-tolerance mechanism with especial reference to the role of small heat-shock proteins (sHSP) in desiccation/drought and heat tolerance
- To identify potential genes and molecular markers (AFLP and ESTs) related to drought, heat, cold and establish criteria and identify suitable genotypes for subsequent breeding programmes and to initiate QTL analysis

Achievements:

- Identified key physiological parameters and genotypes useful for screening and breeding water-use-efficient lines, including potential donor sources for improving drought tolerance.
- Established marker-trait associations, particularly with root traits, providing a basis for Marker-Assisted Selection (MAS) and future validation through mapping populations and core reference groups.

Project title: A Comprehensive Study on Argulosis: Host-parasite Interaction With Respect to Modulation of Innate and Specific Immune Responses, and Development of Preventive or Control Measures

Project Code : 1020
Duration of the project : December 2007 – January 2012
PI Name : Dr P.K. Sahoo
Lead Centre : ICAR-CIFA, Bhubaneswar

Objectives:

- To study the prevalent and dominant species of *Argulus* in the major carp aquaculture zones of India
- To study the interspecific innate immune responses in atleast one *Argulus*-susceptible and one *Argulus*-resistant carp species
- To identify and measure the level of expression of pro-inflammatory cytokines and immune-related genes (interleukin 1, iNOS, transferrin, beta-2-microglobulin, complement 3) during the infestation in susceptible carp species
- To detect and differentiate dominant defence proteins in fish skin mucus (acute phase proteins)/serum (anti-*Argulus* antibody, if any) of susceptible or resistant species before and after infection
- To study the immunogenic components of the parasite to check the suitability as a candidate antigen for vaccination

Achievements:

a) Publications:

- Kar B, Mohanty J, Hemaprasanth KP, Sahoo PK (2015) The immune response in rohu, *Labeo rohita* (Actinopterygii: Cyprinidae) to *Argulus siamensis* (Branchiura: Argulidae) infection: kinetics of immunogene expression and innate immune response. Aquaculture Research. 46:1292–1308. doi:10.1111/are. 12279.
- Sahoo PK, Mohanty J, Garnayak SK, Mohanty BR, Kar B, Hemaprasanth KP, Jena JK (2013) Estimation of loss due to argulosis in carp culture ponds in India. Indian Journal of Fisheries. 60(2):99-102.
- Sahoo PK, Mohanty J, Garnayak SK, Mohanty BR, Kar B, Jena J, Hemaprasanth KP (2013) Genetic diversity and species identification of *Argulus* parasites collected from major aquaculture regions of India using RAPD-PCR. Aquaculture Research 44:220 230. doi:10.1111/j.1365-2109.2011.03025.
- Hemaprasanth KP, Kar B, Garnayak SK, Mohanty J, Jena JK, Sahoo PK (2012) Efficacy of two avermectins, doramectin and ivermectin against *Argulus siamensis* infestation in Indian major carp. *Labeo rohita*. Veterinary Parasitology. 190:297– 304. DOI: 10.1016/j.vetpar.2012.05.010.

- Sahoo PK, Hemaprasanth KP, Kar B, Garnayak SK, Mohanty J (2012) Mixed infection of *Argulus siamensis* and *Argulus japonicus* in carps: Loss estimation and comparative invasive pattern study. *Crustaceana*. 85:1449-1462.
- Saurabh S, Mohanty J, Garnayak SK, Sahoo PK (2012) Identification of immunodominant polypeptides of the freshwater fish lice *Argulus siamensis* (Wilson) - preliminary findings. *Indian Journal of Fisheries*. 59(1):103-106.
- Sahoo PK, Mohanty J, Hemaprasanth KP, Kar B, Mohanty BR, Garnayak SK, Jena JK (2012) Egg laying strategies and effect of temperature on egg development of *Argulus siamensis*. *Journal of Parasitic Diseases*. doi: 10.1007/s12639-012-0148-6.
- Saurabh S, Mohanty BR, Sahoo PK (2010) Expression of immune-related genes in rohu (*Labeo rohita* (Hamilton)) by experimental freshwater lice *Argulus siamensis* (Wilson) infection. *Veterinary Parasitology*. 175(1-2):119-128. DOI: 10.1016/j.vetpar.2010.10.001.
- Saurabh S, Sahoo PK (2010) Non-specific immune responses of Indian major carp (*Labeo rohita* (Ham.)) to freshwater fish louse, *Argulus siamensis* (Wilson) infestation. *Indian Journal of Fisheries*. 57 (2):45-53.
- Saurabh S, Sahoo PK, Mohanty BR, Mohanty J, Jena JK, Mukherjee SC, Sarangi N (2010) Modulation of the innate immune response of rohu (*Labeo rohita* (Hamilton)) by experimental freshwater lice *Argulus siamensis* (Wilson) infection. *Aquaculture Research*. 41(9):326-335. doi:10.1111/j.1365-2109.2010.02538.x

**Project title: Sustainable Biomass Alternative to Fossil Fuel based Urea-
Generation of Hydrogen feedstock from Agro residue and Biomass**

Project Code : 1021
Duration of the project : December 2007 – January 2010
PI Name : Prof. M.S. Hegde
Lead Centre : IISc. Bangalore

Objectives:

- Produce wood gas by wood gasification and analyse chemical composition of wood gas with one Kg of wood per hour burning rate.
- Find (discover) an efficient water gas shift reaction catalyst to convert CO and methane into hydrogen.
- Coat/load catalyst on high surface area ceramic honeycomb.
- Study in the laboratory, CO and Methane conversion to hydrogen by WGS reaction.
- Come up with one or two efficient and new catalysts that are better than the existing commercial catalysts.
- Study biomass availability and document feasibility.
- Set up a chemical reactor (pilot plant) to convert wood gas into hydrogen.
- Try to prepare pure hydrogen – via preferential CO oxidation (PROX)
- Separate carbon dioxide and nitrogen from hydrogen
- If possible, reduce nitrogen content by burning wood in oxygen instead of air

Achievements:

a) Publications:

- Deshpande PA, Hegde MS, Madras G (2010) A Mechanistic Model for the water gas shift reaction over noble metal substituted ceria. *AIChE Journal*. 56(5):1315-1324.
- Singh P, Hegde M.S. (2010). Sonochemical synthesis of $\text{Ce}_{1-x}\text{Fe}_x\text{O}_{2-\delta}$ ($0 \leq x \leq 0.45$) and $\text{Ce}_{0.65}\text{Fe}_{0.33}\text{Pd}_{0.02}\text{O}_{2-\delta}$ nanocrystallites: OSC and WGS study. *Dalton Trans.* 2010, 44 10768-10780.
- Gupta A, Hegde MS (2010) $\text{Ce}_{0.78}\text{Sn}_{0.2}\text{Pt}_{0.02}\text{O}_{2-\delta}$: A new non-deactivating catalyst for high purity hydrogen production via water gas shift reaction and autoexhaust catalysis. *Applied Catalysis B: Environmental*. 99(1-2):279-288. doi.org/10.1016/j.apcatb.2010.06.034.

- Singh P, Hegde MS (2010) Sonochemical synthesis of $\text{Ce}_{1-x}\text{Fe}_x\text{O}_{2-\delta}$ ($0 \leq x \leq 0.45$) and $\text{Ce}_{0.65}\text{Fe}_{0.33}\text{Pd}_{0.02}\text{O}_{2-\delta}$ nanocrystallites: oxygen storage material, CO oxidation and water gas shift catalyst. Dalton Transactions. 44:10768-10780.
- Hegde MS, Madras G, Deshpande PA (2010) Pd and Pt ions as highly active sites for the water-gas shift reaction over combustion-synthesised zirconia and zirconia-modified ceria. Applied Catalysis B: Environmental. 96(1-2):83-93. doi.org/10.1016/j.apcatb.2010.02.004.
- Sharma S, Deshpande PA, Hegde MS, Madras G (2009) Non-deactivating nanosized ionic catalysts for water-gas shift reaction. Industrial & Engineering Chemistry Research. 48:6535-6543. /doi.org/10.1021/ie900335k.

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