



National Fund for Basic, Strategic and Frontier Application Research in Agriculture

NFBSFARA is a platform for developing scientific capacity, partnership (beyond the traditional NARS) and culture, and is providing support for basic and strategic research as a source of continuous flow of knowledge required for solving agricultural problems of present and of future.

NFBSFARA undertook four major tasks— selection and awarding new projects; monitoring ongoing projects; creating awareness for the need and nature of the basic research for agriculture among institutions within and outside the traditional NARS; and assisting scientists in developing meaningful winning projects.

New Projects

During the year, 25 new projects were awarded with a total budget of ₹ 50.10 crore. These are in the following strategic priority areas: Conservation agriculture and climate change (7); Biotic stresses (10); Water quality and productivity (1); Alternate energy for agriculture (2); Use of nanotechnology for agriculture and studies on environmental safety of this technology (1); *RNAi* gene silencing technology (1); Minimization of agricultural waste and maintenance of product quality (3).

Monitoring and evaluation

Eleven Advisory Committee meetings (including seven joint meetings of more than one project) were held during the year for 25 projects. The Empowered Committee also reviewed once the large projects. All the projects were reviewed together by the Empowered Committee on 22 and 23 July 2013, and the Committee appreciated the overall progress of different projects. Seventeen completed projects were evaluated by peers. Eleven of them scored above 70%; the projects scoring very high had high quality publications/ patents too. A survey of Principal Investigators (PIs) indicated satisfaction level of scientists of about 90% with the steps and methods followed for the project development and implementation.

Awareness creation

Six workshops were conducted to create awareness about (i) the nature of the basic and strategic research projects that ICAR wants, (ii) priority problem areas, (iii) about NFBSFARA, and its working and philosophy, and (iv) conception and development of Project Ideas and Concept Notes on projects through participatory discussions. These were held at the Assam Agricultural University, Jorhat (8-9 July 2013), Central Agricultural

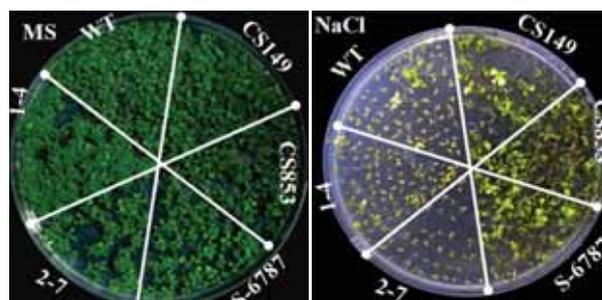
University, Barapani campus (11-12 July 2013), NAARM, Hyderabad (12-13 August 2013), NIRJAFT, Kolkata (23-24 August 2013), NDRI, Karnal (6-7 September 2013) and CIFE, Mumbai (27-28 September 2013). In all 229 scientists participated from 92 NARS and 48 non-NARS institutions.

SALIENT ACHIEVEMENTS

Subject-wise classification of 50 projects awarded before 2013 in different priority areas is as follows: Conservation agriculture and climate change (9); Biotic stresses(13); Water quality and productivity(5); Alternate energy for agriculture(4); Micronutrients and their use efficiency(1); Precision and controlled-environment agriculture(2); Use of nanotechnology for agriculture and studies on environmental safety of this technology (1); *RNAi* gene silencing technology (5); Minimization of agricultural waste and maintenance of product quality (4); Improvement of fibre quality in fibre crops (5); Development of pod-borer resistance in pulses (1). One patent entitled “An autoclavable microencapsulation system with multi stage break-up two fluid nozzle” has been filed.

Moisture-stress tolerance in rice

A high- throughput non-destructive method based on the near infra-red (NIR) and shortwave infra-red (IR) hyperspectral signatures has been developed for quantifying relative water content (a criterion of moisture-stress tolerance) of rice-plant in laboratory and pot-culture. Twenty candidate genes related to moisture-stress tolerance from rice have been cloned, and 33 different plant transformation vectors have been constructed. Two rice genes, *OsFBX257* (F-box protein) and *OsHOX22* (homeodomain protein), when expressed



Arabidopsis seedlings grown on MS media

Arabidopsis seedlings grown on MS media supplemented with 100 mM NaCl for induction of moisture stress



in *Arabidopsis*, a model plant, behaved as a negative regulator for moisture- stress tolerance.

Moisture-stress tolerance in groundnut

Bacillus subtilis, *B. firmus*, *B. tenquimensis*, *Pseudomonas aeruginosa*, *Acinetobacter* sp., *Enterobacter* spp., *Brevibacterium* sp., *Alcaligenes* spp. and *Pantoea* sp. identified as seed endophytic bacteria of groundnut appear to help groundnut-plant in tolerating salinity and moisture-deficit stress.

Resistance to pod-borer in pulses

- Thirty- two independent primary transgenics of chickpea and 211 of pigeonpea have been established. In preliminary insect-feeding assay with T₂ lines of pigeonpea, mortality of gram pod-borer was up to 90%, 60% and 75% in leaf, flower and pod, respectively.



Feeding pattern of neonate pod -borer larvae in leaf bioassay involving *Cry2Aa*-transgenic lines (T₂) and non-transgenic plants

- MicroRNAs have been identified which could shut down chitin production and larva development of pod-borer upon their force feeding. Tobacco plants carrying microRNA have been produced for validation. Viral DNA in nucleopolyhedrovirus (NPV) of *Helicoverpa armigera* has been characterized using inhibitor of apoptosis (*iap*) gene with specific primers and the ssDNA binding protein encoding gene of NPV with specific primers. This method would help identifying NPV proteins leading to control of pod-borer.

Enhancement of bioavailability of iron in soybean and rice-grains

Putative transgenic rice-plants have been developed using RNAi technology. These plants showed 5-7 fold increase in inorganic phosphorus and up to 40% decrease in phytic acid content in selected rice transgenic (T₂) lines. Phytic acid decreases bioavailability of iron in grains. Similarly, up to 60% reduction in phytic acid content was observed in selected transgenic lines (T₂) in soybean.

Fibre strength in cotton

A simple staining of developing fibre using calcoflour white is useful in identifying high- fibre strength genotypes of cotton.

Tolerance to weedicides

Rice-plants with enhanced (through molecular

techniques) activities of EPSP synthase and sulfonylurea insensitive acetolactate synthase encoding genes showed tolerance of non-selective herbicides, glyphosate and sulfonylurea, respectively.

Disease resistance in animals and fish

A method has been developed for isolation and maintenance of peripheral blood mono-nuclear cell (PBMC). *In-vitro* model of PBMC-derived macrophages has been developed for functional analysis of immune-response gene against *Mycobacterium avium* ssp. *paratuberculosis* (MAP) and *M. fortuitum* (MF) for goat/ buffalo and MF for fish. An *in-vivo* model for studying infection parameters due to MF infection in fish has been developed.

Whole genome has been sequenced for goat. Transcriptome and small RNA profiles of macrophages of goat and buffalo when infected with MAP and MF have been worked out to understand immune-response genes in goat.

Food and feed quality enhancement

- The fungal isolates, LF1-2F1, LF1-5F1 and SV-2F2, reduced gossypol (up to 57%) and improved crude protein (up to 4%) and lysine content (up to 0.32%) in cotton-seed cake and this enhanced its value as a poultry-feed. A solid-state fermentation process has been optimized using a combination of *Pleurotus sajorcaju* and *Saccharomyces cerevisiae* and *S. cerevisiae* + *Candida tropicalis* for maximum detoxification to the extent of 0.04% of free gossypol and total gossypol (0.87%) in cotton-seed cake and improved lysine content within 36 to 48 hours.
- Mode of action of *siRNA* in inhibiting fatty acid regulatory enzyme ELOVL6 in pig mesenchymal stem cell lines has been studied. This will help further using *siRNA* to reduce fat content in pig. Laboratory methods have been optimized for estrus synchronization, harvest and grading of different stages of developing transgenic pig embryos expressing *siRNA* against *ELOVL6* and *SCD1* genes and their transfer.
- Pediocin is a wide-spectrum bactericide usable in food material. Encapsulated pediocin in microcapsules made of sodium alginate (2.0% w/v), guar gum (0.22% w/v) and phosphatidylcholine (0.15% w/v) supplemented with nonencapsulated free pediocin gave best antimicrobial activity against *Listeria innocua* up to 48 hours in Brain heart infusion (BHI) broth media.

Bioenergy

- Delignification and saccharification of agricultural biomass are important steps for production of bioethanol. A broad database of cellulose- and lignin-degrading microbes available in diverse growing conditions has been prepared. Three microbes, *Myrothecium roridum*, *Trametes hirsuta*

and *Steptomyces griseorubens*, have been found efficient in delignification of paddy- straw, carrot grass etc. *M. roridum* released 408.33 mg/g reducing sugar from bio-pretreated paddy- straw and 376.75 mg/g from sterilized carrot- grass after 32 hr of enzyme action. Fermentation of hydrolysate derived from alkali-treated paddy-straw and carrot- grass with *S. griseorubens* produced ethanol (16.5g/litre) with addition of β - glucosidase. Plant pathogens like *Xanthomonas axonopodis* pv. *punicae* and *Phoma exigua* ITCC 2049 showed saccharification of lignocellulosic biomass.

- Calcium, nitrogen and phosphorus starvation and magnesium and common-salt supplementation increased cellular lipid content in three selected microalgae, *Scenedesmus obliquus*, *Chlorella vulgaris* and *Chlorella minutissima*, to the extent of 42, 43 and 61%, respectively. Up to 91% biodiesel could be obtained from transesterification of microalgal oil at the laboratory level. A low- cost medium with fertilizers used for agriculture has been standardized. Extraction and quantification protocol for β -carotene, a precursor of vitamin A, from microalgae has been developed. □