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

The Indian Council of Agricultural Research established a National Fund for supporting basic and strategic research. Objective of the project is to build capacity for basic, strategic and cutting-edge application research for generating knowledge needed for solving existing, emerging or future agricultural problems and to make India a global leader in frontier research for agriculture. A number of important activities regarding policy matters, calling for new projects, project monitoring and project execution were taken up.

The strategic priority areas on which the National Fund would focus during the XII Plan period were thoroughly deliberated upon, and on the basis of the discussion and further deliberations by the Empowered Committee following 12 strategic areas were identified, viz. Conservation agriculture and climate change, Biotic stress, Water quality and productivity, Alternate energy for agriculture, Micronutrients and their use efficiency, Precision and controlled-enironment agriculture, Use of nanotechnology for agriculture and studies on environmental safety of this technology, *RNAi* gene silencing technology, Minimization of agricultural waste and maintenance of product quality, Improvement of fibre quality in fibre crops, Mechanization in horticulture and Research in agricultural extension system.

Two projects of national importance, namely 'Phenomics of moisture deficit and low temperature stress tolerance in rice' and 'Development of pod borer resistant transgenic pigeonpea and chickpea', have been initiated this year. A strong monitoring system is an integral part of the project system.

To bring the three mega basic and strategic research projects of the Council, namely 'National Agricultural Bioinformatics Grid (NABG)' and 'Bioprospecting of genes and allele mining for abiotic stress tolerance' (under NAIP) and 'Phenomics of moisture deficit and low temperature stress tolerance in rice' (under NFBSFARA) under the same platform so that they start integrating and complementing each other with a long-term focus and continuity; a regular interaction mechanism has been initiated.

The salient achievements from the existing projects are as follows.

Prediction of downy mildew in cucurbits: A rule based prediction model for predicting onset of downy mildew disease, the most important disease of cucurbits, has been developed and validated combining average daily temperature and night leaf wetness duration. The model has been validated on three cucurbit crops at the experimental station in 2010 and 2011 with 75% success. The model is now being tested in farmers' fields.

Molecular diagnosis of fungal disease of tuber crops: Laboratory based molecular diagnosis techniques of important fungal diseases of cassava, taro, elephant's foot yam caused by *Phytophthora palmivora* and *Sclerotium rolfsii*, based on species specific primer and nucleic acid probes, were developed.

Resistance to gall midge in rice: Rice genotypes, namely TN 1 (suscepetible to gall midge and carries no gene for resistance) and Kavya (a genotype which was resistant but has became susceptible to new virulent strains and carries a resistance gene *Gm1*), were compared by molecular analysis for their response to gall midge infestation. The study of a selected set of 20 genes related to plant defence system revealed certain distinct variations in early response (24 hr after GMB4M infestation) in Kavya compared to TN 1. Kavya mounted an elevated defence response during early hours (24 hr) of virulent gall midge infestation than the other. This induced defence is suppressed during later hours (120 hr) by the virulent insect with the counter defence mechanism and resulted in plant susceptibility.

Peptide elicitors for defence response in Indian mustard: The genes like *BjEli1* and *BjEli2* which trigger the defence system of mustard plants to aphids have been identified, cloned and validated. The results of fungal bioassay established the capability of *BjEli1* to restrict the disease lesion size and intensity of the alternaria blight fungus, *Alternaria brassicae*. Plants of the mustard cultivar BYSR constitutively expressing *BjEli2* showed higher expression of several defence genes, and in insect bioassay using aphid nymphs significantly inhibited growth and multiplication of aphid population.

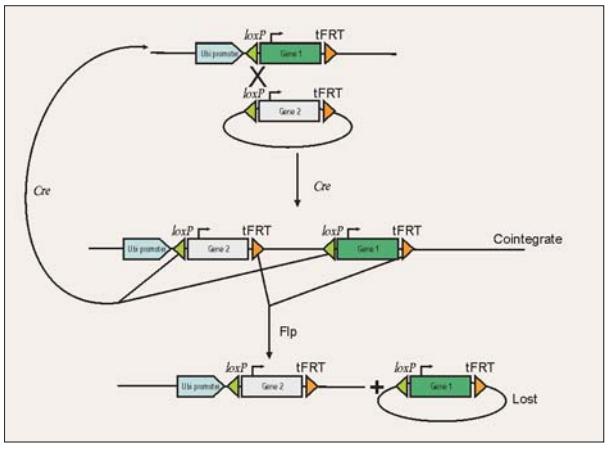
Native *Agrobacterium* strains for biocontrol of crown gall of peach: A native non-gall forming isolate of the bacterium *Agrobacterium radiobacter*, isolate UHFBA-218 (Cherry 2E-2-2) showed control of crown gall of peach by 92.14% compared to 74.19% by strain K-84 of the bacterium that is used world over as seed treatment on peach. The disease incidence in untreated plants was 84.92%.

Gene for distinguishing insecticidal nuclear polyhedrosis viruses: A gene *Lef-8* gene can be used for quick and correct identification of NPVs specific to different insect species.

Resistance mechanism of cattle breed to FMD and development of a marker vaccine to identify non-vaccinated cattle: Genetic analysis showed that the native Malanadugidda breed resistant to FMD is genetically distant from other indigenous breeds and better maintained as pure breed with less gene flow. Thus these animals may be used in breeding for disease

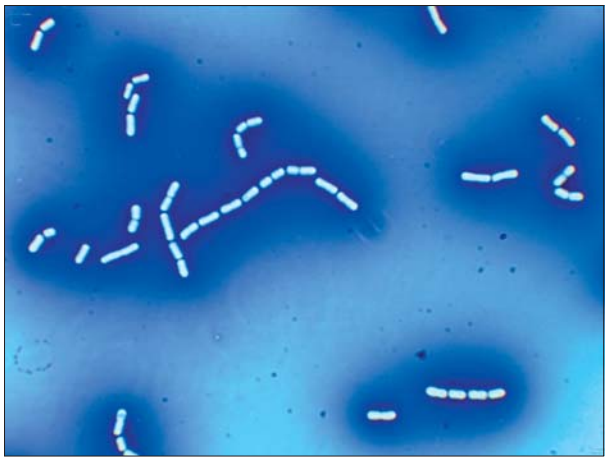
resistance. A positive marker vaccine for FMD virus was prepared by incorporating GFP epitope and tested in 12 crossbred female calves. Competitive ELISA showed the presence of GFP-epitope specific antibodies. This approach can be used to develop marker vaccine for endemic countries like India. A novel FMD virus Asia 1(Indian Vaccine strain) replicon based viral vector for vaccine research and development has been developed.

Technique for integration of transgenes into desired chromosomal sites during transformation: The available plant transformation methods have a score of challenges such as random integration, multiple transgene copies and unpredictable transgene into a predetermined locus in the plant genome. A technique has been developed for gene integration into the desired sites on chromosomes in a plant system. The efficacy of the method has been tested in rice and the success rate has been as high as 17%. This technique has been for the first time applied in transgenic research studies in plants.



Schematic diagram of the target gene integration strategy

High salt and temperature stress-tolerant endophytes in groundnut: Among the 52 bacterial and 20 fungal endophytes from the Rann of Kachchh characterized, so far, five fungal and 38 bacterial endophytes were found to tolerate 10% NaCl concentration and 50ºC temperature which would be useful in using them to study alleviation of abiotic stress tolerance in groundnut, if any.



Bacillus megaterium RE7: a root endophyte of groundnut

Autotransgenic fish for increased growth: Functional autotransgene constructs having Histone 3 and β-actin promoter driving growth hormone gene along with 3´ regulatory sequence for *Clarias batrachus* (Indian catfish magur) were made and gene delivery methods were successfully standardized: microinjection in Zebrafish and in magur embryo and sperm mediated electroporation in magur. Autotransgenic fish could be made with these constructs and confirmed by three independent assays: PCR, sequencing and southern blotting and functionality of the autotransgene was confirmed by western analysis.

An efficient fungal strain for pretreatment of lignocellulosic substrate for energy production from biomass: Delignification of biomass like paddy straw is an essential step for enhanced sugar recovery by enzymatic saccharification for bioenergy. The fungus, *Tremetes hirsuta* MTCC136 showed high ligninase and low cellulase activities. Solid state fermentation of paddy straw with *T. hirsuta* enhanced carbohydrate content by 11.1% within 10 days of incubation. The amount of value-added lignin recovered from the *Tremetes* pretreated paddy straw was higher than controls. Enzymatic hydrolysis of the *Tremetes* pretreated paddy straw yielded more sugars than controls and yields enhanced till 120 hr of incubation.