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Agricultural Human Resource Development

To keep pace with the agricultural growth, high priority has been accorded to upgrade quality of higher agricultural education in Agricultural Universities (56 AUs), Deemed-to-be-Universities (5 DUs) and Central Universities (4 CUs) with Agricultural faculties under the National Agricultural Research System (NARS). During this year, three new universities, viz. Kamdhenu Agricultural University, Raipur, Shimoga University of Agricultural Sciences, Shimoga and Tamil Nadu Fisheries University, Nagapattinam, have been established by the respective State Governments. The Division through the implementation of Scheme-Strengthening and Development of Higher Agricultural Education in India, assists the AUs to plan, undertake, aid, promote and coordinate agricultural education in the country. The scheme has enabled these institutions in building excellence in specific strategic areas in education and research through Niche Area of Excellence (NAE), promoting holistic higher agricultural education by blending knowledge, skill and attitude through Experiential Learning Units, RAWE, and related aspects concerning infrastructural development, gender mainstreaming and capacity building of the students.

Infrastructural support

The infusion of development grant continued during the year for renovation and refurbishing of structures, maintenance of equipment, support for course curriculum delivery, student and faculty amenities, personality development and overall strengthening of infrastructure in AUs. In the XI Plan, a total of 89 girls, 42 boys and 35 international hostels, 37 educational museums and 45 examination halls were supported in 52 AUs. Creation and strengthening of educational museums helped in showcasing important research and agricultural innovations in a systematic manner leading to increased awareness and opportunity to access the displayed products/technologies. Smart



Girl's Hostel, Dr YSRHU, Vgudem

classrooms, supported by the Council have enabled effective delivery of course curriculum, ensuring enriched learning experience. The support for the curriculum delivery enabled introduction of the practical manuals leading to improvement in conducting practical classes. Support provided for student and faculty amenities/tours/capacity building encouraged their participation in seminars, symposia, workshops etc. Education Technology Cells were strengthened by publication of booklets, pamphlets and exhibit model products. The total outlay during the year was ` 413.50 crore. In addition, the special grant of ` 120.00 crore was provided to eight AUs to strengthen the infrastructure for higher agricultural education and research in cutting edge areas.

Niche Area of Excellence

Support for creating excellence in specific areas to 21 ongoing and one new centre of Niche Area of Excellence (NAE) on *Integrated Centre for Drought Research: Genetic Enhancement of Crops by Molecular Approaches and Phenotyping*, UAS, Bengaluru, has been extended during the year. The programme encourages and enhances competitiveness in agricultural research and education and focuses on capacity building in the cutting edge areas. Presently, seven programmes under animal, two in fishery sciences, one in post harvest technology, two in plant sciences, six in natural resource management, one in horticulture and two in plant protection are being supported. The VI Annual review meeting to fine tune the programmes was organized at New Delhi on 21 June 2012. NAE websites were created and maintained by the concerned centers.

Significant achievements under the programme are:

- Two different Newcastle disease virus (NDV) genotypes (NDV 2k3 and NDVD1) prevalent in India have been adapted to Vero cells for vaccine production and tetrARMS PCR for differentiating field and vaccine virus by targeting the pp38



tetrARMS PCR for differentiating field and vaccine viruses of Marek's disease



Talent attracted towards Agricultural Education

Publicizing the scope and relevance, e-initiatives like online submission of application, observance of "Education Day" in ICAR institutes and SAUs resulted in attraction of talented youth towards Agricultural Education. It is encouraging that out of 1847 candidates admitted in 55 Agricultural Universities through All India Entrance UG Examination (2013-14), 42% candidates secured 80% and above marks in their qualifying Intermediate Board Examinations, the highest being 99%. About 82% candidates had secured above 60% marks.

gene of Marek's disease virus (MDV) was developed.

- Flow cytometry revealed decreased percentage of CD4+ and CD8+ cells in T-2 toxin fed birds along with significant reduction in body weight, feed conversion ratio and lymphoid cells. High arginine in combination with vitamin E ameliorated the toxicity.
- Efforts were made towards establishing the tissue bank constituting the tissue blocks, H & E stained slides, special stained slides and non-stained paraffin sections from the animals suffering from different diseases in the programme on *Animal Disease Registry*.
- The surface plasmon resonance (SPR) biosensor chip was prepared by immobilizing recombinant -N proteins of PPRV. The positive and negative sera samples were tested on SPR biosensor platform. PPR monoclonal antibody 4G6 was affinity purified and immobilized on gold sensor surface.
- Molecular characterization of Indian myxosporeans parasites such as, carp gill infecting *Myxobolus catmrigalae* and carp fin infecting *Thelohanellus caudatus* was done at WBUAFS, Kolkata. High value species *C. punctatus* was reared successfully in pond -cage aquaculture.
- A protein rich novel pearl millet and sorghum based extruded snack with high nutritional, antioxidant and sensory properties was developed. A stable process for incorporating β -carotene from red capsicum in extruded products was also standardized.
- In the groundnut transgenics, co-expressing stress responsive Transcription Factors (AtABF3, AtHB7, AtDREB2A) diverse stress responsive genes were upregulated for tolerance to salt, drought and oxidative stresses.
- Success was achieved in developing rice lines suitable for semi-irrigated aerobic cultivation through trait introgression via molecular breeding and marker assisted selection through multi-parent intercross strategy.
- Two major QTLs, *QSB.bhu2B* and *QSB.bhu7D* associated with spot blotch resistance in wheat were successfully validated for use in marker

assisted backcross breeding program for transfer of spot blotch resistance in susceptible, but promising wheat varieties.

- Infestation by *Sclerotium rolfsii* in groundnut JL24 seeds controlled by application of actinobacterial isolates *Streptomyces shandongensis* AUDT 217 and AUDT 242.
- The late leaf spot resistance was successfully transferred in well adapted, but disease susceptible cultivars of groundnut (JL24 and TMV2) by transferring the QTL using the markers. F₁s were confirmed from JL 24 × GPBD 4 and TMV 2 × GPBD 4 for producing BC₁F₁.
- Vegetable based cropping system, mash-garlic and soybean-garlic, were observed as the most remunerative systems with benefit: cost ratio of 4.84 and 4.72, respectively under organic farming. Cucumber beetle and blister beetle of rice bean could be managed effectively by using 4 sprays of 5% extracts of neem seed kernel and *Lantana*, respectively. Effective management of plant hoppers and leaf-spot of beans, and downy mildew in cucumber was validated through traditional ways without using chemical pesticides.
- A manually operated Check Row Planter for dry seeding of rice seeds at a spacing of 25 cm × 25 cm was designed, developed and evaluated. The cost of sowing was 653/ha that was significantly less than manual transplanting (2,777/ha).
- The programme on identification of insects and mites facilitated the addition of 8681 new insects and mites to the existing collection. A complete manual was prepared with pictorial keys for 150 and 30 families of insects and mites, respectively.
- Optimized physicochemical and nutritional parameters for increased cellulase production in two important biocontrol species *Trichoderma harzianum* and *Trichoderma reesei*. Maximum production was recorded with 1% (w/v) of sucrose at 35°C, pH 6.
- Centres organized farmers' meet, awareness camps, workshops for rural agricultural extension workers, veterinary officers of State Animal Husbandry Departments, arranged demonstrations and provided consultancy for adopting the technologies generated. Five trainings were organized for the capacity building of the faculty in various areas. During the year 30 students initiated /pursued research for M.Sc./M.V.Sc./M.Tech and 11 students for Ph D degrees with the support of NAE programmes.
- Farmers were motivated that led to conversion of 55 acres of salt affected waste land in districts Fazilka and Muktasar, to aqua farms. The success story was widely covered by media.

Entrepreneurship development

Experiential learning modules were provided that aimed at giving experience-based and skill oriented training to the undergraduate students to promote



entrepreneurship, knowledge as well as marketing skills by providing hands on experience, through end –to-end approach in product development and thus, it links education with professionalism. During last one decade 351 modules were established. Twenty-four new modules were established during this year in various areas, viz. protected cultivation and nursery management of horticultural crops, apparel manufacturing, production and designing of information material, processing of milk and milk products, aqua-farming and ornamental fish production and fish post- harvest technology.

The outcome of salient modules is as given below:

- The module on cultivation and utilization of medicinal plants enabled the students in production and successful marketing of herbal produce, besides empowering them with knowledge about cultivation and biodiversity assessment. The production of vegetable and fruits under protected cultivation gave high returns of up to ` 5.00 lakhs /annum at UAS, Raichur. High value crops like, capsicum, cucumber, tomato and flowers (gladiolus) were raised in polyhouses.
- Produced bio-inputs like bio-fertilizers, bio-agents and vermicompost giving impetus to organic farming.
- Students designed and created visiting cards, digital albums, posters, handouts, fliers, lab journals etc. in module on designing and development of information materials.
- The production, management, marketing and economics of bird rearing were important components of broiler production modules.
- Students were trained on various aspects of processing of cereals, vegetables, fruits, flowers, spices, milk, fish etc. alongwith their quality control, packaging and marketing strategies.
- Skills of apparel manufacturing and designing imparted by exposing students to technologically advanced industrial machines. Competency developed for software usage in pattern and textile designing. Permanent sale outlets for finished products were established in some universities.

Rural Agricultural Work Experience (RAWE)

RAWE provided real life experience at KVK's instructional farms, industrial attachment etc. as per the prescribed programme. It was implemented in adopted villages under the supervision of scientists. Activities focused on intensive observations /analysis of socio-economic and technological profile of the farm families in rural areas, participatory extension approach and acquaintance with farming situations, farm practices and interaction with farmers. About 8,000 students were benefited under RAWE through Council's support.

Library strengthening

The libraries were further strengthened and modernized with the financial support of ` 41.80 crore.

The networking and online access to the literature ensured equity and availability of learning resources in the main campus as well as off campuses colleges and ensured procurement of additional need based journals not covered under CeRA. Some universities established book banks for the underprivileged students. All the universities have their own websites. RFID technology was installed in college libraries for easy and more secure stock management. A virtual centre for innovative learning and teaching was established at IARI, New Delhi.

National Information System on Agricultural Education (NISAGENET)

An online software system was developed for the management, monitoring, record keeping, and showcasing the activities of AUs. All the AUs were included in this system with improved and effective data entry by the participating universities and their constituent colleges. Sensitization-cum-training workshops for the nodal officers of the NISAGENET were also organized to sensitize and expedite data management. The reference guide for data management was prepared and uploaded on the website.

Support under Tribal Sub-plan

Financial support of ` 23.60 crore was provided in 10 states during the year under Tribal Sub-plan. The tribal population were trained in the areas of farm mechanization, integrated farming system, value addition, resource conservation, seed production, backyard poultry, quality milk production etc. ensuring livelihood security and employment generation by different universities. These programmes were executed in 340 villages that benefitted 7500 tribal farmers.

Manpower development

- **All-India Entrance Examination for Admission to UG:** The 18th Undergraduate Examination for degree programme for admission up to 15% seats in agriculture and allied subjects, other than veterinary sciences, including the award of National Talent Scholarships (NTS) was conducted on 20 April 2013. The examination attracted a record 96,096 applications out of which 86,661 candidates appeared and 1847 candidates were finally recommended for admission in 57 AUs through counselling. All the candidates, who joined a university outside their State of domicile, were awarded NTS of ` 1000/month.
- **All-India Entrance Examination for Admissions to PG:** The examination was conducted for admission to 25% seats in PG programme at 65 agricultural universities, including award of ICAR Junior Research Fellowships (JRF). A total of 21,294 candidates appeared in the examination out of 23,785 applicants, and 2,408 candidates were finally recommended for admissions. In all, 474 students were awarded JRF in 20 major subject groups.



- **All-India Competitive Examination for ICAR Senior Research Fellowship for Ph.D.:** The examination was held on 21 April 2013 at 16 centres across the country. Based on the merit, a total of 190 Senior Research Fellowships were awarded and 661 candidates were declared qualified for Ph.D admission without fellowship in 14 major subject groups and 56 sub-subjects.
- **Globalization of agricultural education:** Two Hundred Forty Seven Candidates from 37 countries like Afghanistan, Bangladesh, Bhutan, Burundi, Cambodia, Congo, Egypt, Eritrea, Ethiopia, Fiji, Guyana, Ghana, Indonesia, Iraq, Iran, Kenya, Mauritius, Maldives, Malaysia, Mozambique, Mongolia, Morocco, Myanmar, Namibia, Nepal, Niger, Nigeria, Rwanda, South Africa, Sudan, Sri Lanka, Syria, Tajikistan, Turkmenistan, Vietnam, Uganda and Zimbabwe, exercised their preference to join various agricultural universities under different fellowships or as self-financed candidates.

Capacity building

Summer/Winter Schools and Short Courses: Summer and Winter Schools (SWS) and Short Courses of 10 to 21 days duration (40 SWS of 21 days and 33 Short Courses for 10 days) were organized at ICAR Institutes and State Agricultural Universities in key areas of agriculture and allied sciences like Advances in Farm Equipment Designs, Advances in Micro-irrigation Technologies, ICT Oriented Strategic Extension, Decision Support Systems in Agriculture, Development of Web Application for Agriculture Information, Farmers Empowerment of Farming Community, Entrepreneurship Development, Functional Genomics and Proteomics, Resilient Agriculture, Geo-statistical Modelling, DNA Barcoding, Molecular Biology, Integrated Disease Management, Climate Change, Bio-fuels, Agri-business and Market Intelligence, Education Technology, etc.

Centres of Advanced Faculty Training: The 31 Centers of Advanced Faculty Training provided training to 830 scientists/ faculty members from the National Agricultural Research System through 43 training programs in cutting edge areas of agricultural and allied sciences. A Capacity Building Program portal was developed as a workflow based online management system of all training programs sponsored by Agricultural Education Division. It provides information on all training programmes, training proposal submission and evaluation, submission of application by a trainee, availability of e-books/lecture notes of a training and reports for all categories of users and several other features.

Promotion of excellence and HRD

ICAR National Professor Scheme: For promoting excellence and creating a culture of basic research at national level, ten positions of National Professors have been created. Major achievements of ongoing

ICAR National Professorial scheme are as follows.

Designs for single factor and multi-factor experiments and their applications in agricultural systems research: General methods of construction of incomplete block designs for bioassays were obtained for multiple parallel line and slope ratio assays, besides, A-optimal block designs for asymmetric parallel line assays and a method for assessing the influence of masking in outlier detection for designed experiments with correlated errors. Optimization technique based algorithms were developed for obtaining efficient incomplete block design for given number of treatments, blocks and block sizes. A method of construction of row-column designs in two rows for estimation of main effects and two factor interactions in 2n factorial microarray experiments based on orthogonal parameterization was also developed. Sample Survey Resources Server provided with an online calculator for determination of sample size for estimating the population mean (population proportion) for simple random sampling design.

Development of technologies for subsoil structure modification, deep placement of fertilizers (P & K) and micro-nutrients and Controlled field traffic for different cropping systems of Indo-Gangetic Plains: The 'Pant-ICAR Animal Drawn Six-in-One Tillage Outfit' for small and marginal farmers has been commercialized. Yet another innovative gadget 'Pant-ICAR Animal Drawn Multipurpose Tillage Device' was developed for performing field operations like soil tilling, puddling, weed raking, interculture/crop thinning, land levelling and clod crushing operations.

Assessment, prediction and enhancement of biotic carbon sequestration in agricultural soils: Impact of land use on quantity and quality of soil organic matter studied in the agro-ecological sub-region 4.1 of the country. Cultivation resulted in decline in total (21-36%) and labile pools of soil organic carbon (10-34%), dehydrogenase enzyme activity (2.8-3.4 mg/kg/h) and disruption of macro-aggregates. Agroforestry and sugarcane agro-ecosystems exhibited greater rate of soil C rehabilitation compared to rice-wheat and maize-wheat systems. Evaluation of results from sites across India showed that balanced fertilization results in C sequestration by a factor 1.19 and application of organic manure along with balanced NPK increases it by 1.48 times.

Broadening the genetic base of Indian mustard (Brassica juncea) through alien introgressions and germplasm enhancement: Gene controlling determinate plant growth habit in mustard cloned and sequenced for the first time and gene pools characterized. East European accessions of mustard were found to be distinct from Indian and Chinese mustard genotypes. Two gene pools co-existed in Indian mustard. Heterotic gene pools defined for the first time in this crop.

Allele Mining for Agronomically Important Genes in Wild Rice Germplasm and Stress Tolerant Landraces of Rice Growing in the Hot Spots: Accessions of wild rice were collected from the natural habitats in remote



villages of Uttar Pradesh, Bihar, Gujarat and Himachal Pradesh. A web portal was created for 300 wild rice accessions including additional 58 lines acquired from NBPGR, New Delhi with information on geographical location, passport data, morphological data and photographs of each of the wild rice accessions. The wild rice accessions were evaluated for drought, submergence and salinity tolerance under controlled conditions and resistant lines identified.

Design, construction and validation of DNA chips for virus identification and differentiation: It was observed that the ribosomal RNA depletion increases the efficiency of virus detection with the microarray chip. Not so random hexamer (hexamers from which ribosomal specific hexamer were removed) improved the efficiency of both dnase-sispa and microarray chip for virus detection. A DNA chip for identification of viruses infecting fish, animals and birds was tested successfully.

Changing consumption pattern in India: Opportunities for diversification towards high value commodities through production and marketing linkages: Pace and pattern of diversification of agriculture across states analyzed considering data for last 30 years of both production and consumption. Indian agriculture sector is witnessing a transition from food grains to High Value Commodities (HVCs).

Metagenomic analysis and manipulation of buffalo rumen ecosystem to improve fibre utilization and reduce methane production: Essential oils have synergistic effect on methane inhibition in buffaloes. Essential oils are well known anti-methanogens, but sometimes these oils have a detrimental effect on feed degradation. The *in vitro* screening of three essential oils (L, A and C) revealed methane inhibition varying between 10-25% at a concentration of 1.0 µl/ml reaction mixture along with 29-33% depression in feed degradability. But a mixture of the three at a similar concentration caused methane inhibition by 85.6% and 31% reduction in the feed degradability, indicating a synergistic effect of the mixture of essential oils on methane inhibition.

Development of chromosome segment substitution lines (CSSL) of rice from elite x wild crosses to map QTLs/genes for yield traits: CSSL are very useful genomic resource for mapping QTLs/gene for complex traits. One wild accession each of *O. nivara* and *O. rufipogon* was shortlisted as donor based on high photosynthetic efficiency and crossed with Swarna and MTU 1010 as recipients to develop CSSLs in these lines and true hybrids were obtained. Elite backcross inbred lines (14) derived from Swarna × *O. nivara* were grown along with 6 best varieties of different duration to select the best BIL for mapping QTLs for yield traits.

ICAR National Fellow Scheme: To provide support and develop strong centers of research and education around outstanding scientists, 25 ICAR National Fellow positions have been provided in National Agriculture Research System. Highlights of the ongoing projects are given in following paragraphs.

Improvement of strain of Chaetomium globosum, a potential antagonist of fungal plant pathogens for enhanced bioefficacy and developing molecular markers for its identification: Phylogenetic relationship among different isolates of *Chaetomium* species based on β tubulin and *gpd* gene sequences revealed that *gpd* sequences separated *C. globosum* isolates from other *Chaetomium* species with transition/ transversion ratio of 1.773. A novel diene lactone hydroxylase gene involved in secondary metabolite biosynthesis and biodegradation was cloned and sequenced from *C. globosum*, with 96% homology with hypothetical protein of *C. globosum* in NCBI database, 87% with *Myceliophthera thermophila* and *Thielavia terrestris*.

Decontamination of pesticide residues from edible commodities: Endosulfan could be detoxified using nano form of a transition metal as catalyst that resulted in formation of an environmentally safe compound, different from toxic α or β endosulfan or endosulfansulfate. It was also observed that neonicotinoid insecticides are harmful to non-target honey-bee based on the results of Photo Fenton's reaction used for degradation of neonicotinoids and synthetic pyrethroids.

Assessment of sustainability of treated / developed watersheds in rainfed agro-eco-sub-regions of peninsular India using GIS and remote sensing: A trans-disciplinary monitoring and evaluation procedure for assessment of impact of watershed projects has been developed with a copyright (L-45448/2013). It facilitated measurement of sustainability of watershed projects on agricultural productivity, livelihood security, economic viability, environmental protection and social acceptability at three spatial-levels viz., household (HH), field (FL) and watershed-level (WL). Study indicated that 15 - 35 % of area in treated watersheds were sustainable in Telengana region in AP owing to higher agricultural income and production due to cultivation of more number of crops (higher Crop Diversity Index).

Development of ELISA based immunodiagnosics for Classical Swine Fever: Double antibody sandwich ELISA was used to detect classical swine fever virus (CSFV) antigen in 432 samples of pigs from Asom and other North Eastern states and 56 (12.96%) of the samples were found positive for CSFV antigen. E2, 5'UTR and NS5B genes fragments of the selected CSFV were cloned and sequenced. The predominant genogroup of CSFV in Asom was 1.1 and genogroup 2.2 was found in Arunachal Pradesh.

Assessing soil quality key indicators for development of soil quality index using latest approaches under predominant management practices in rainfed agroecology: In alfisol soils of Hyderabad, the organic carbon content increased as the soil particle size (sieve size) decreased. It varied from 1.5 to 2.6, 2.3 to 3.6 and 3.4 to 5.0 g kg⁻¹ with the mean values of 2.23, 2.82 and 4.03 g kg⁻¹, respectively in 0.5 to 1.0, 0.25 to 0.5 and 0.1 to 0.25 mm sieve sized particles, respectively. Sorghum grain yield significantly



correlated with advanced soil quality indicators such as labile carbon (LC), particulate organic carbon (POC), and aggregate associated organic carbon.

Evolution of textile articles through processing of wool with silk waste and cotton to create entrepreneurial skills in rural women: Fibers were processed and analysed for their physico-chemical properties. Ergonomic assessment of handlooms and weavers was carried out to make ergonomically suitable handloom for reduced fatigue and better productivity. Fabric weaves were designed using Computer-aided Design (CAD), without warp change (draft plan) through novelty yarns, different coloured waft yarns, variety yarn counts. Simulated impressions of woven designs, their draped effects were prepared.

Identification and quantification of phosphatase hydrolysable organic P sources for plant nutrition and refinement of a non-destructive technique for phosphatase estimation: *Bacillus megaterium* JCT13 was isolated and developed with ability to mycosynthesize P nanoparticles 5-80 nm size from phytin salts within 24 h at a concentration of 0.1 mM. The foliar application of nano-P @ 640 mg ha⁻¹ resulted in 80 kg P equivalent yield of clusterbean and pearl millet under arid field condition.

Nanotechnology in aquaculture: an alternative approach for fish health management and water remediation: Laboratory synthesized CuO, ZnO, Ag and Ag-TiO₂ nanoparticles had broad spectrum antibacterial activity whereas, Zn and ZnO nanoparticles were effective against fungus and algae. CuO nanoparticles showed a good hatching and survivability of larvae and kept the microbial load at lower level without affecting other water quality parameters. Dietary administration of selenium nanoparticles improved the antioxidant enzymatic activities and muscle Se concentration of *Labeo rohita*.

Development of soy and multigrain based nutritionally balanced functional foods for children: Functionally and nutritionally rich porridge and biscuits were developed using cereals, millets, pulses, oilseeds, dairy ingredients and fruits with superior protein, fat, anti-oxidant, phenolic and flavonoid content incorporating multigrain concept in ready-to-eat, wholesome food. The multi-nutrient biscuits were commercialized and a MOU was signed for their production and distribution at a commercial scale. Both the products are ready to be distributed as mid-day meal snacks to under-nourished children in Madhya Pradesh.

Precision nutrient management using GIS-based spatial variability mapping under Upper and Middle Gangetic Plain Zones of India: The work on assessment of spatial variability in soil fertility status in the Bhabar and Tarai Zone (BTZ), Mid-Western Plain Zone (MWPZ) and South-Western Plain Zone (SWPZ) was done under first, second and third pre-dominant cropping systems. Fertilizer use in different cropping systems was skewed in favour of N, whereas use of K, S and micronutrients were neglected. Homogeneous

fertility management zones were prepared using Ordinary Exponential Kriging in Arc-GIS 10.1 environment in order to develop precision nutrient prescription. Among different fertility management options maximum area was under Low N-Medium P-Medium K category (63, 68 and 56% area in BTZ, MWPZ and SWPZ, respectively).

Development and evaluation of neuraminidase DIVA marker vaccines against highly pathogenic H5N1 avian influenza viruses in chickens: Areassortant rgH5N2 virus, generated through plasmid based reverse genetics, was successfully tested in specific pathogen free chickens for safety and non-pathogenic character as a vaccine candidate virus. It was characterized by nucleotide sequencing, growth in embryonated chicken eggs and virological tests for its suitability as vaccine seed virus. A mineral oil adjuvant vaccine was formulated using the inactivated rgH5N2 virus and is currently under testing.

Development of Commercially Viable Process Technologies for Weaning Food based on Underutilized Crops of Uttarakhand: Protocol for formulation of weaning food based on composite flour of underutilized crops of Uttarakhand Finger millet and *Amaranthus*, using submerged state fermentation technology comprising *Lactobacillus planatarum* as starter culture was developed. *Lactobacillus planatarum* reduced anti-nutritional characteristics upto 55-65% and the resultant flour was further used as a base ingredient for development of value added products like weaning mix, snacks, breads etc.

Functional Genomics, Epigenetics and Gene Silencing Technology for Improving Productivity in Poultry: Functional analysis of candidate genes, expressed in muscle of broiler chicken was studied. Three important candidate genes, i.e. Activin receptor 2A (ACTVNR2A), Activin receptor 2B (ACTVNR2B) and Follistatin (FSTN) involved in controlling growth, were characterized in broiler chicken. The ACTVNR2A haplogroups showed significant effect on body weight at 6 weeks.

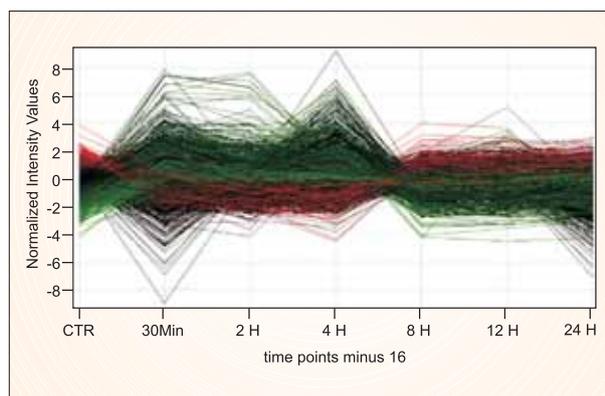
Studies on phyto-semiochemicals involved in Insect-Plant interactions of major horticulture pests: Oviposition site-selection by the oriental fruit fly, *Bactrocera dorsalis*, was mediated through an innate recognition template tuned to γ -octalactone. A mango cue that instigated oviposition behavior in the mango fruit fly, *B. dorsalis* was discovered. In an insect-host model that comprised *Bactrocera cucurbitae* and *Sechiumedule*, the insect oviposites eggs into the fruit and the fertilization process of the egg ended with a ROS blast. This process instigated the plant to produce more ROS resulting in increased levels of hydrogen peroxide and nitric oxide triggering defence against the invading eggs.

Development of transgenic goat using sperm-mediated gene transfer (SMGT) method and its use as a bioreactor for producing novel proteins of therapeutic importance: The urinary-bladder specific expression of UPKII gene using semi quantitative RT-



PCR was validated. Using electroporation mediated *in vitro/in vivo* gene transfer protocol, the reporter gene was successfully integrated in spermatozoa and spermatogonial germ cells of goat.

Whole genome wide SNPs based assessment of genetic relationship of Indian native cattle adapted to different agroclimatic condition: Buffalo mammary epithelial cells (MECs) were utilized as *in-vitro* model to evaluate the impact of heat stress both at cellular and transcriptional level. The primary buffalo MECs were exposed to 42°C and subsequently harvested at 8 different time points (30 min to 24 h). Cytotoxicity analysis indicated reduced viability, increased dead cells/ apoptotic cells and loss in plasma membrane integrity post heat stress. Microarray based transcriptome analysis revealed a total of 2256 transcripts to be differentially expressed at different time points post heat stress. Maximum transcriptional response was observed immediately after heat stress (30 min-4h). The responsiveness of MECs can be used as a model to understand the molecular changes in buffalo mammary gland in response to environmental heat load.



Transcription signature (line plot) of buffalo MECs in response to heat stress *in vitro*

Comprehensive Screening of Target, Non target and Unknown Emerging Organic Contaminants in Fruits and vegetables by GC-MS and LC-MS: A high resolution LC-MS based targeted and non-targeted residue screening method was developed for efficient separation, identification and confirmation of pesticides, plant growth regulators and emerging contaminants of different chemical classes in fresh fruits and vegetable matrices and processed products like wines and beverages. The pre-harvest intervals pertaining to maximum residue limits of the European Union were generated for trifloxystrobin, tebuconazole in tomato, fluopyram, tebuconazole in green chilli, fipronil, difenoconazole in okra and imidacloprid, carbendazim, kresoxim methyl, flubendiamide, λ -cyhalothrin, captan and hexaconazole in brinjal.

Development of sensitive and specific diagnostic assays for detection of Trypanosoma evansi infection in animals using modern molecular tools: A highly sensitive polymerase chain reaction (PCR) assay was developed for detection of *Trypanosoma evansi* infection

in animals using gold standard TBR1/2 primers designed from repetitive sequence of mini-chromosome satellite DNA. The assay revealed amplification in multiple bands of 164 bp size with detection sensitivity of 0.1 pg of purified parasitic genomic DNA or 1-10 trypanosomes per ml in blood of experimentally infected mice.

Development of novel immune-potentiator molecules from fish host and pathogens for broad spectrum disease control in freshwater aquaculture: The full sequence information of some innate immune molecules and antimicrobial peptide genes (hepcidin, apolipoprotein A1, natural killer cell enhancing factor, lysozyme G, linker histone H1M, NAD(P)H quinoneoxidoreductase complex I and interleukin 15) of *Labeo rohita* was generated. The synthetic peptide of hepcidin was able to inhibit the bacteria *Aeromonashydrophila*, *Edwardsiellatarda* as well as *Pseudomonas putida* at a concentration of 50 μ M at 3 h post incubation.

Environmentally sustainable termite control: integrative and inclusive approach of frontier and indigenous technologies: Accession numbers were obtained for two genes of *Heterotermes indicola* [KF170428 and KF170427]. Termiticidal seed treatments were found without deleterious effect on seedlings. (1) Wheat - chlorpyrifos @2; fipronil 4; and imidacloprid 3–5 ml/kg seeds. (2) Soybean-chlorpyrifos @4; imidacloprid 4–6; and fipronil @5–7 ml/kg seeds. (3) Maize - fipronil @ 5; and imidacloprid@1.5–5 ml/kg seeds. Benefit: cost ratio (BCR) worked out for termiticides as soil application (chlorpyrifos, imidacloprid, fipronil - granules and liquid, microbial pesticides - *Beauveria bassiana* and *Metarhiziumanisopliae*, EPN commercial formulation *Steinernemathermophilum*, botanicals - neem and neem + garlic derivatives). Fipronil (0.3% G) gave maximum yield (BCR: 4.90), but chlorpyrifos (20%EC) was most cost-effective treatment (BCR: 5.84).

Emeritus Scientist Scheme

The ICAR continued to operate Emeritus Scientist Scheme as a structural method of utilizing Skill Bank of the outstanding superannuated professionals of NARS. Some of the major findings of the projects under this scheme are:

- Allelic variability was observed in the camel populations of Kachchi breed and Kharai strain of Kachchi breed that clearly established Kachchi camel as a distinct breed.
- A number of new monomers of tannins detected in Acacia pods.
- Developed pathogenicity gene (L-gene) and 3B3 deleted replicons using the available FMDV replicon for use of developing attenuated vaccine. GFP gene was inserted in the replicons carrying L and 3B3 deletions.
- Variations available in red rice varieties were studied for morphological and quality characters in hills of Himachal Pradesh. Some of the lines had high content of iron and zinc.



An e-learning portal launched

A centralized e-learning portal has been designed and developed by ICAR for refinement, updation, maintenance and sustenance of the e-learning in the field of agricultural education. The portal has been hosted on the web accessible at <http://ecourses.iasri.res.in> for teachers, researchers' and students. The online access of the interactive and multimedia UG level e-Course contents of five disciplines namely Horticulture, Fisheries Science, Dairy Technology, Home Science, Veterinary and AH has been made available as guest users.

The contents are available as free downloadable component from the same portal for remote area institutions/ faculty/ students, for offline usage. The downloaded file content folder could be independently executed offline on the local computers and courseware contents can be used exactly in the same manner as the existing CDs/DVDs contents created for offline e-learning. This will eliminate the process of physical supply of e-course contents on (CDs / DVDs) by post/ courier services. At present more than 1250 users for online access and about 2600 users for offline free downloads have been registered from NARS in the portal. More than 13000 e-course content files from different disciplines have been downloaded by the registered users. The portal link was provided on the ICAR as well as SAUs web sites. Sensitization cum awareness workshops for nodal officers of different disciplines were organized during the year.

- Trend analysis of the productivity changes in onion over the years in relation to changes in climatic factors was carried out in districts of Karnataka.
- The mapping of geo-temporal fish resources was achieved through a software developed in Mangalore catchment area to identify both commercial and non-commercial fish resources.
- MO-10 isolate of *Moringa oleifera* having high oil content was identified. Phenotypic screening of 34 genotypes was completed for seed and oil content of Moringa plant.
- Long time series secondary data on eleven climatic and oceanographic parameters were collected. The trend in chlorophyll anomaly was reasonably well related with the sea surface temperature trend (SST) along the Tamil Nadu coast.

Quality assurance and reforms

Accreditation: Quality assurance in higher agricultural education was pursued through accreditation of agricultural universities, their constituent colleges and programmes. Seven universities, including GADVASU, Ludhiana; CCSHAU, Hisar; CSKHPKV, Palampur; UAS, Raichur; KVAFSU, Bidar; UBKV, Cooch Behar and IGKV, Raipur were accredited and Peer Review Teams of IVRI, Izatnagar; PAU, Ludhiana; NDU&T, Faizabad; ANGRAU, Hyderabad and MAFSU, Nagpur were constituted.

India-Africa fellowships: To support the agricultural human resource development in Africa through formal education of African scientists/faculty and students, India has been offering fellowships to the nationals of African continent for pursuing Masters and Ph.D programme in agriculture since 2010. A total of 37 African candidates have completed their programmes so far. During current academic year, 187 applications were recommended for admission to 32 AUs, after considering the unutilized slots of previous years.

India-Afghanistan fellowships: To strengthen and expedite the process of human resource development in Afghanistan, India with its wide experience, infrastructure and facilities and competent scientific and teaching manpower in most of the aspects of Agricultural and allied sciences, offered 115 fellowships during the year for higher studies in Indian AUs for Afghan nationals. Since 2010, eight Afghan nationals have completed their programme. During the academic year 2013-14, a total of 134 candidates were selected and 54 have joined the programme.

ICAR International fellowships: With an objective to develop competent human resource and showcasing the strengths of Indian ICAR-AUs system, 58 ICAR International Fellowships, since 2009-10, have been awarded for pursuing Ph.D programme at the Indian and overseas universities. So far, 29 students have completed their studies in leading overseas Institutions, mainly in USA, UK, Taiwan, Germany and Canada.

ASEAN-India working group

ASEAN- India Working Group on Agriculture and Forestry was formed to facilitate promotion of joint efforts for development of Human Resource and Technology for increasing production and productivity of Crops, Livestock, Fish, Natural Resource Management, Post- harvest technology and value addition etc. In view of increasing population of India and ASEAN countries, productivity and profitability enhancement per unit area and per unit energy are critical for sustainable agricultural growth in the region. ASEAN-India Working Group on Agriculture & Forestry will help in attaining these objectives by means of development of joint ventures in Agriculture, Exchange of technologies, Exchange of scientists/experts and germplasm.

A conference of Heads of Agricultural Universities and Research Institutions of ASEAN countries and Vice-Chancellors of Indian Agriculture Universities and Central Agriculture University was organized in New Delhi during 19-20 February 2013 to identify strategy and to work out on the modalities of co-operation among the Agriculture Universities and research institutions in ASEAN and India. The conference discussed the issues of exchange of scientists from agriculture research among the agriculture research, education and extension institutions in ASEAN member states and India; ASEAN-India fellowship for higher agricultural education in India and ASEAN countries.



The 3rd meeting of ASEAN India Working Group on Agriculture and Forestry was held during 6-7 May 2013 at NASC Complex, Pusa, New Delhi. Various joint collaborative projects proposals were discussed during the meeting. The 3rd meeting of Agriculture Ministers of ASEAN and India was held on 28 Sep, 2013 in Kuala Lumpur, Malaysia where Hon'ble Minister of Agriculture, and Food Processing Industries, Shri Sharad Pawar led the Indian delegation. It was agreed in the meeting to enhance ASEAN-India cooperation in Agriculture, especially to address the challenges of food security through capacity building, agricultural education and research and development. At this occasion, the 3rd issue of the Newsletter on India-ASEAN cooperation on Agriculture and Forestry was released. Directorate of Knowledge Management in Agriculture (DKMA) in the ICAR has been entrusted to bring out this Newsletter on half yearly basis in collaboration with all ASEAN Nations.

Liaising with other departments and academic institutions

Liaising with MHRD, AICTE, UGC, NCERT, CBSE, IAUA etc. was maintained to improve the quality of higher education in the country, in general and of agricultural education in particular through synergies and exchange of information.

Policy for higher agricultural education

A high level committee constituted by President ICAR Society submitted its report on *National Policy for Higher Agricultural Education*. The committee had several interactions with stakeholders and discussed policy issues with Vice Chancellors of SAUs, CAUs, DUs, Industry Representatives, Former and Existing DGs and DDGs of ICAR and students before evolving the Policy Document. The Policy document has been divided into 6 Sections viz. Status of Higher Agricultural Education, Issues and Concerns, Vision and Mission, Recommendations and Epilogue besides, guidelines for establishment of Central Agricultural Universities. The salient policy recommendations of the committee concern; Attracting students to agricultural education, Academic reforms, Curriculum improvement, Faculty improvement, Inclusive growth, Institutional Development, Governance and Structure, Globalization and partnership, Centre- State Partnership, Non-formal education and Financial Sustainability.

National Academy of Agricultural Research Management (NAARM)

NAARM, Hyderabad continued its innovative activities under the broad areas of capacity building, research, postgraduate education and policy support.

The NAARM finalized and signed a Memorandum of Understanding with the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru with the intent to develop cooperation and collaboration in research for development, training and other agreed activities, keeping in view the increasing national and global need to create,

disseminate, apply and exchange knowledge in agriculture for the sustainable development of farmers by increasing their income.

NAARM is the lead centre for an international project "Assessments of the Maize Situation, Outlook and Investment Opportunities to Ensure Food Security in Asia" funded by the International Maize and Wheat Improvement Centre (CIMMYT), Mexico and International Institute of Tropical Agriculture (IITA), Nigeria. The partner countries are Bangladesh, China, Indonesia, Nepal and Pakistan. Besides, consultancy was given to many agricultural research institutions in India and abroad for customized teaching, training and research support.

Capacity building programmes: The Academy organized 64 programmes for 1,798 participants that included 2 foundation courses for Agricultural Research Service (FOCARS) and 62 other senior-level training programme.

Capacity building programmes conducted by NAARM, Hyderabad during 2012-13

Name of capacity building programme	Number of CBP	Number of participants
Foundation Course: FOCARS	2	157
EDP Leadership Development	2	25
MDP Leadership Development (Pre-RMP)	2	77
MDP Agricultural Research Management (HOD)	2	44
MDP/Faculty Development Programmes	12	280
Refresher Courses/Summer Schools	3	89
Workshops/Seminars	21	555
Off-campus Programmes	18	514
Orientation Programmes	2	57
Total	64	1,798

Customized off-campus programmes were conducted for IIT, Kharagpur, GADVASU, Ludhiana, CAZRI, Jodhpur, IARI, New Delhi, PDKV, Akola, TANUVAS, Chennai, KVAFSU, Bidar, CSWRI, Avikanagar, IGKV, Raipur, IGFRI, Jhansi and Directorate of Mushroom Research, Solan.

Research: The NAARM addresses research needs in the major areas of Research Systems Management, Information and Communication Management, Human Resources Management, Agribusiness Management, Education Systems Management and Extension Systems Management.

Postgraduate education: Twenty-four students of Postgraduate Diploma in Management in Agriculture (2011-13 batch) successfully completed the diploma and were placed in reputed organizations. Twenty-three students of 2012-2014 batch are currently



undergoing their Summer Internship. Fifty-two students of Postgraduate Diploma in Technology Management in Agriculture (2011 batch) completed the course.

Policy support: A draft training policy for the ICAR was prepared and agreed in the Governing Body Meeting of the ICAR Society. Implementable recommendations that evolved from a workshop on “*Effectiveness and Training Transfer of Centre for Advanced Faculty Training (CAFT) Programmes*” at NARS were compiled and circulated to all stakeholders.

Round table discussion on Open Educational Resources (OER): Prospects and Strategies for OER and Creative Commons in SAARC Countries was the

area of round table discussion held at NAARM to formulate open educational resources. Twenty eight participants including Directors, Head of Divisions and Principal Scientists, from Hyderabad research institutes participated in the discussion.

Participation in AP-TEC 2012: NAARM partnered with the Andhra Pradesh Technology Development Corporation (AP-TEC) as a knowledge partner for the AP-TEC 2012 at Guntur. The focal theme of the conference was Technologies for Modern Agriculture. The objective was to expose the farmers and the State Department Officials to modern agricultural technologies.

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