Volume 18 No. 1 January-March 2012

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद
Agrisearch with a human touch

भाकृअनुप
ICAR

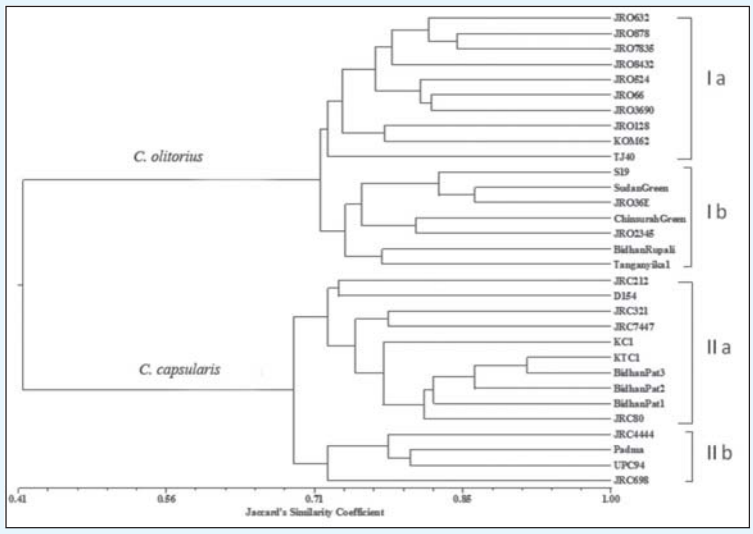
ICAR NEWS
A SCIENCE AND TECHNOLOGY NEWSLETTER

RESEARCH UPDATE

PROMISING TECHNOLOGIES

Gene-targeted markers for molecular characterization in plants

During the last two decades, many DNA-based molecular-marker techniques have been developed for higher plants. Use of some of these, such as restriction fragment length polymorphism (RFLP), random amplified polymorphic DNA (RAPD), simple sequence repeats (SSR), inter simple sequence repeat (ISSR) and amplified fragment length polymorphism (AFLP), has been popular for different applications.



Genetic relationships among 31 jute cultivars based on 165 SCoT markers generated with 22 primers

With the rapid strides in the genomics research, it has become possible to scan functional regions of the genome and to use gene-targeted markers, instead of the anonymous markers. These gene-targeted markers are derived from the polymorphic sites within the genes, targeting mostly exons, introns or promoter regions. Start Codon Targeted (SCoT) polymorphism is one such technique that is based on the short conserved region in the plant genes, surrounding ATG translation start (or

Indian Council of Agricultural Research
Krishi Bhavan, New Delhi 110 001, India
www.icar.org.in

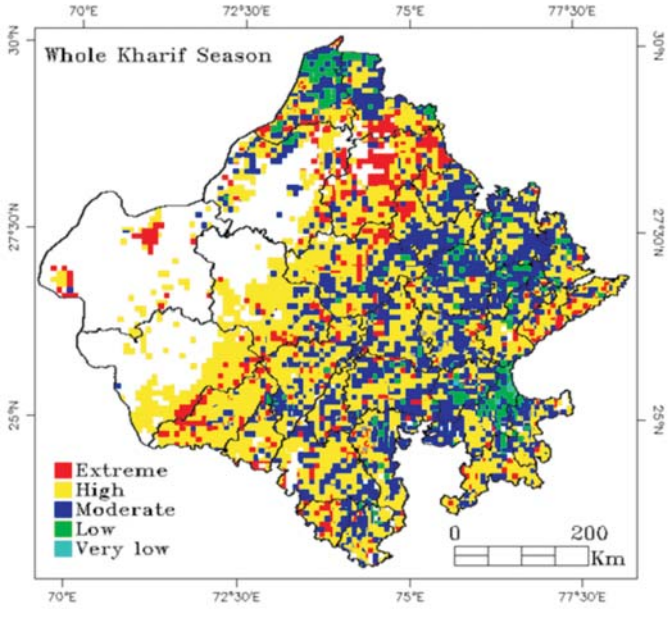
initiation) codon. This has been used for diversity analysis in 31 cultivars of jute, belonging to two cultivated species— tossa jute (*Corchorus olitorius*) and white jute (*Corchorus capsularis*). Total genomic DNA from 31 cultivars was extracted using CTAB method. Thirty-six SCoT primers were used for PCR amplification; of which 22 produced sharp and scorable 165 bands. The results obtained using SCoT markers were comparable with the results reported earlier using other marker techniques– RAPD, AFLP and SSRs. The percentage of polymorphism in *C. olitorius* and *C. capsularis* was found to be 67.3 and 62.4. Genetic dissimilarity among *C. olitorius* cultivars was slightly higher than *C. capsularis* cultivars. All 31 cultivars were grouped into two groups, which were representative of *C. olitorius* and *C. capsularis* species. All cultivars could also be unequivocally differentiated from one another using SCoT markers. The study showed that gene-targeted SCoT markers were useful for diversity analysis and for identification of jute cultivars; and these markers can be used for other crop-plants.

M.K. Rana, Sonika Singh and **Amit Kumar Singh**
National Bureau of Plant Genetic Resources
Pusa Campus, New Delhi 110 012
e-mail: director@nbpgr.ernet.in

Geospatial approach for assessing vulnerability to agricultural drought

Quantification of vulnerability to agricultural drought and its intra-seasonal variations is essential to design area-specific crop contingency and mitigation plans. The drought vulnerability of an area is the function of its exposure to hazard and its sensitivity and adaptive capacity.

A new geospatial methodology to assess vulnerability to drought and its intra-seasonal variabilities in rainy season (*kharif*) was demonstrated for Rajasthan. Frequency and intensity of Standardized Precipitation Index (SPI), computed using monthly rainfall data (1951-2006), was used as an indicator for the hazard probability, and frequency and intensity of the satellite-derived Vegetation Condition Index (VCI) during 1982-2006 and soil water-holding capacity were used as indicators for the crop sensitivity, and percentage area under irrigation was used as an indicator for the adaptive capacity. All indicators were combined together by computing weights using multi-criteria-analysis to arrive at the final Composite Vulnerability Index. The vulnerability was mapped separately for early, mid and late season and for whole of *kharif*.



Agricultural drought vulnerability rating map of Rajasthan during *kharif*

About 11%, 53%, 31%, and 5%, respectively, of the state's net sown area were indicated to be affected with extreme, high, moderate and low vulnerability in whole of *kharif*. District-level drought vulnerability statistics showed significant correlation with Human-Development Index (HDI) and foodgrains productivity; thus validating the methodology. Under the National Disaster Management Policy, 2009, all States are required to undertake hazard exposure and vulnerability mapping to natural hazards; and proposed methodology can be extended to other states.

Vinay Sehgal, Rajkumar Dhakar and **Ravender Singh**
Division of Agricultural Physics
Indian Agricultural Research Institute
New Delhi 110 012
e-mail: sehgal@iari.res.in

PUSA *bajra* puffs – Ready-to-eat nutritious snack

Pearl millet-based ready-to-eat puffed product (PUSA *bajra* puffs) was developed through extrusion processing. *Extrusion processing is a high temperature and short time (HTST) process that produces high quality products with minimum degradation by heat to nutrients in food*. Consumption of 100 g of this product can meet approximately 25% of the *Recommended Dietary Allowance (*RDA) of Fe and Zn in women.

The product could be promising to human population suffering from celiac diseases due to gluten allergy. It is free from artificial colours, flavours, preservatives and oil. And it is organoleptically acceptable to people of different age groups. Its moisture content ranges from 1.25 to 4.5%, and its expansion ratio ranges between 2 and 3, which is ideal. Bulk density of the product

varies from 51 to 82 kg/m^3. Apart from the rich source of micronutrients (Fe=4.51 mg/100g, Zn=2.73mg/100g), the product is rich in total antioxidants (0.1 m mole Trolox /100g) and phenolics (76.5 mg/100g).

S.K. Jha and **R.K. Pal**
Division of Post-harvest Technology
IARI, New Delhi 110 012
e-mail: skj_ageg@iari.res.in; head_pht@iari.res.in

Process parameters for soymilk and tofu from sprouted soybeans

Four commonly used soybean varieties of India were studied to assess their feasibility for using as sprouted soybeans to be a non-chemical, non-thermal pre-treatment for improving quality of soy products. Soymilk was prepared from sprouted and unsprouted seeds with process temperature of 121°C for 25 min. Coagulation of soymilk was done with 3% $CaSO_4$ at 80°C. Sprouted varieties showed 7% increase in protein (fresh basis) in milk and 13% in tofu across the varieties; 24% reduction in fat (fresh basis) in milk and 12% in tofu; 73% reduction in trypsin inhibitor (dry basis) in milk and 81% in tofu; 59% reduction in phytic acid (dry basis) in milk and 56% in tofu.

Tofu from sprouted seeds showed higher protein and whiteness index but its strength was around 43%; lower than its unsprouted counterparts. Taste acceptability showed an increase of 10% and 6.3%; of flavour 23.2% and 11.6% and overall acceptability of 9.9% and 4.4 % for milk and tofu, respectively, from sprouted varieties. An improvement in composition and quality parameters was seen in all tested varieties, showing that sprouting was beneficial for product development. After the initial laboratory-scale trials on the preparation of soymilk, tofu and okara from germinated soybeans using conventional processing parameters, the second phase of the experimentation moved on to pilot-plant scale, where modifications of process parameters were undertaken in preparing soymilk, tofu and okara from germinated soybeans. Soymilk was obtained from the pilot plant using different process parameters — 120°C for 25 min., 100°C for 15 min. and 80°C for 10 min., and 120°C for 25 min. for unsprouted soybean being served as control. The milk and tofu obtained were analyzed for yield, nutritional quality, anti-nutritional profile and texture (tofu).

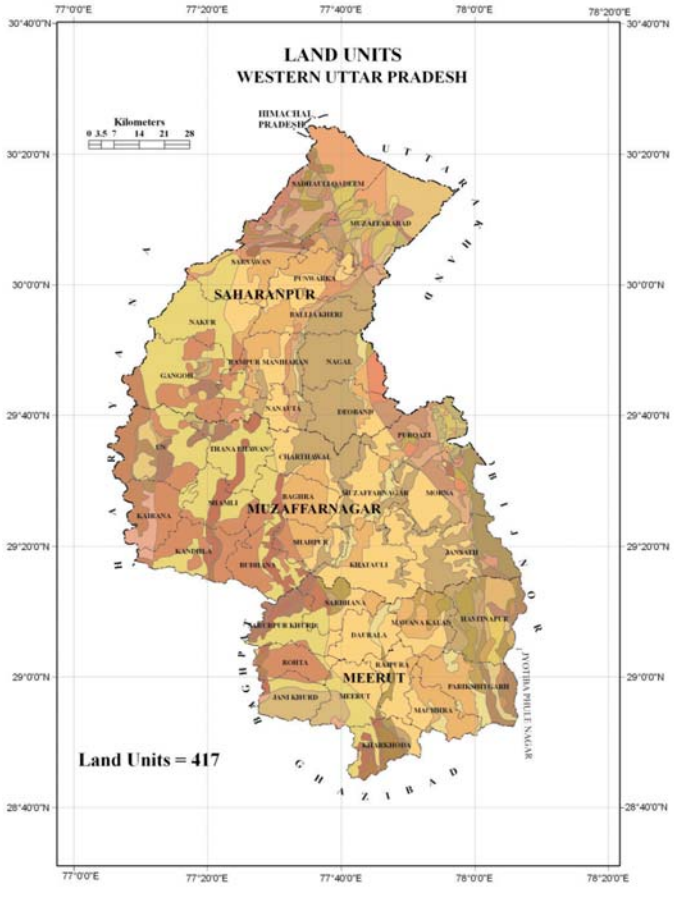
Among the process temperature and time combinations, it was found that soymilk and tofu from sprouted soybeans prepared at 100°C with 15 min. process time were superior in terms of quality, antinutrient reduction, and texture profile.

Increases in yield (16.6% , 42.9%), protein (1.5% , 7.2%), and decreases in fat (2.8% , 34.1%), trypsin inhibitor (13.6%, 16.3%) and phytic acid (40.7% ,61.7%) at 100°C and 15 min. process time were seen in soymilk and tofu, compared to control.

Dipika Agrahar Murugkar
Central Institute of Agricultural Engineering
Nabi Bagh, Berasia Road, Bhopal
(Madhya Pradesh) 462 038
e-mail : dipikaagrahar@yahoo.com

Geospatial technologies for evaluation of potential agricultural productivity

Rapid urbanization and developmental processes in the cities are increasingly in conflict with other forms of land-use, especially agriculture. Geospatial technologies were used to generate spatial and temporal patterns of land-use change in the western Uttar Pradesh (3 districts—Meerut, Muzaffarnagar and Saharanpur) for planning and for sustainable management of the region. The Indian satellite imageries of *kharif* (rainy season) and *rabi* (winter) seasons together revealed shift of land from agricultural to non-agricultural use to the tune of 4.41%; in which conversion of the agricultural land to built-up areas was 2.89% (1998-2006). Geographic information system was used to capture spatial patterns of soil (texture, organic carbon and soil reaction) and climatic (rainfall) characteristics of the region and then integrating them into 38 homogeneous agroecological classes. The maximum area (35.2%) in a soil class was identified with a slightly alkaline *p*H (7.5-8.5), low organic-carbon content (0.1-0.4%) and loamy texture, and the same soil class with the rainfall between 750 and 850 mm occupied the highest area (17.6%) in the region. The agroecological units (soil and climate together) coupled with the block boundaries emerged into smallest units of the management; land units (417 in number).



Homogeneous land units through integration of soil and climatic variations overlaid with block boundaries

Potential yields of major crops, rice, wheat, sugarcane and maize were computed by using crop-simulation models, and their latest(current) yields were obtained through field surveys in the selected land units supplemented with available secondary data. Yield gaps (potential-current) ranged between 3.87 and 6.64 tonnes/ha (6.0 tonnes/ha for maximum land units) in rice, 2.85 to 4.89 tonnes/ha (4.8 tonnes/ha for maximum land units) in wheat, 4.09 to 6.02 tonnes/ha (6.02 tonnes/ha for the maximum land units) in maize and for sugarcane as high as 30 tonnes/ha for maximum land units. A few agri-technological levels were tested for fertilizer and irrigation inputs required to bridge these yield gaps in rice and wheat.

This case study has indicated immense potential in utilizing geospatial components, remote sensing, GIS, GPS and simulation models in an integrated manner to learn about pattern of change in land-use/cover and accordingly in planning for optimal land productivity.

Debshis Chakraborty[1], Ranjeet Kaur[2], Purabi Chanda[3], Sandeep K. Sharma[4], R.N. Garg[1] and Ravender Singh[1]
[1]Division of Agricultural Physics and [2]Division of Environmental Sciences, Indian Agricultural Research Institute, New Delhi 110 012; [3]IL&FS ECOSMART New Delhi; [4]Institute of Medical Sciences Banaras Hindu University, Varanasi (Uttar Pradesh)
e-mail: rsingh.iari@gmail.com

Scientific pig-farming for tribal farmers

Majority of the pig-farmers used to rear only one or two non-descript pigs, which were procured usually from the local market on zero input systems. On an average, each pig used to provide an annual return of ₹3,000, which was considered remunerative. Non-availability of the superior germplasm, lack of balanced feed, lack of purchasing power and small land-holding were perceived as the major problems

The village Gorgara under Rani Development Block of Kamrup (Rural) District of Asom was taken as the adopted village for pig-farming for the following reasons. Villagers were mostly from the backward classes with primary source of income from fishery and pottery, which were no longer sustainable; farmers were not having large plots of land to undertake cultivation; and they had made up their mind to undertake pig-farming as an enterprise.

of pig-farmers in the adopted Gorgara village.

A total of twelve farmers, who were already engaged in pig-farming were selected in the first phase to demonstrate importance of rearing superior animals in a scientific way. The selected farmers were given training on the modern pig-husbandry practices and also exposure visits to institute's farm. Before distribution of pigs, housing requirements and other preliminary necessities for them were ensured at farmer's house at his cost. To each farmer, 2 weaned crossbred female piglets were distributed along with 50% concentrate feed supplementation.

Previously, farmers were practising natural service to their female pigs for which they had to spend additionally ₹300 as hiring expense for auto-van to bring boar from neighbouring village and ₹500 as the charge for the service. After introduction of artificial insemination (AI), farmers could save ₹800; and the piglets born from AI were healthy and were larger in size; fetching higher cost in the market (₹1,500 per piglet). There is a spin-off effect among farmers; neighbouring farmers are also now ready to adopt AI technology. Till date, the institute has conducted more than 800 AIs in the nearby villages and farms with a success rate of above 80 %.

AI born piglets at farmer's field

Cost of piglets (2 – 3 months) before intervention	₹900/ piglet as they were non-descriptive local piglets
Cost of piglets (2 – 3 months) after intervention	₹1,500/ piglet as they were crossbred pigs and bigger in size
Improvement in returns due to introduction of AI with semen of improved pig	₹600/piglet
Economic returns/pig before intervention	₹4,500/ per pig (₹900 × 5 piglets)
Economic returns/pig after intervention	₹12,000/ per pig (₹1,500 × 8 piglets)

Presently, more villagers are motivated to take up scientific pig-rearing practices, and farmers from the nearby villages have bought a total of 95 improved pigs from the institute's farm to rear them for breeding.

National Research Centre on Pig
Rani, Guwahati (Asom) 781 131

Facilities for clean pork production and its value-addition

The state-of the-art slaughterhouse is fully equipped with all modern equipment to replace manual slaughter. It has facilities for hygienic processing of pork and for production of value-added products.

The unit also has an effluent treatment plant, which treats effluent water from the slaughterhouse mixed with blood and fat, and the final treated water will have biological oxygen demand values below the recommended levels.

Currently, the unit is processing frankfurters, hotdogs, cocktails, ham, nuggets, patties, *samosas*, momos from pork.

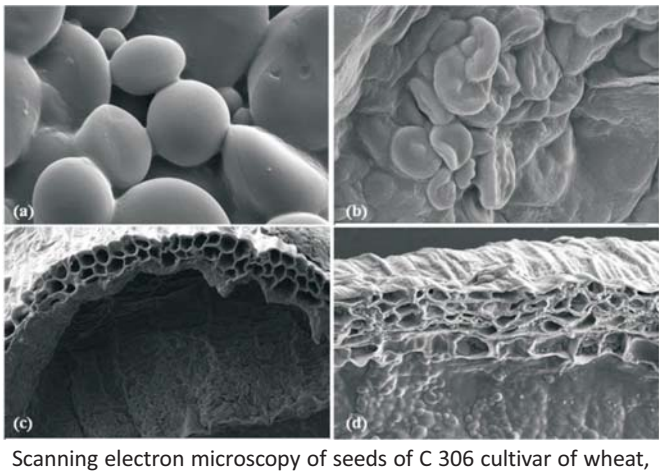
The unit is also undertaking regular research activities on the (*i*) assessment of carcass and meat quality of indigenous pigs and their crosses in comparison to improved pig breeds to standardize carcass grading procedure for indigenous pig breeds and (*ii*) refinement, standardization and popularization of technologies for value-added pork products towards facilitating development of a repository of the standardized technologies for processing value-added pork products. This plant is expected to bring in a major change in the post-harvest management of pigs.

National Research Centre for Pig
Rani, Guwahati (Asom) 781 131

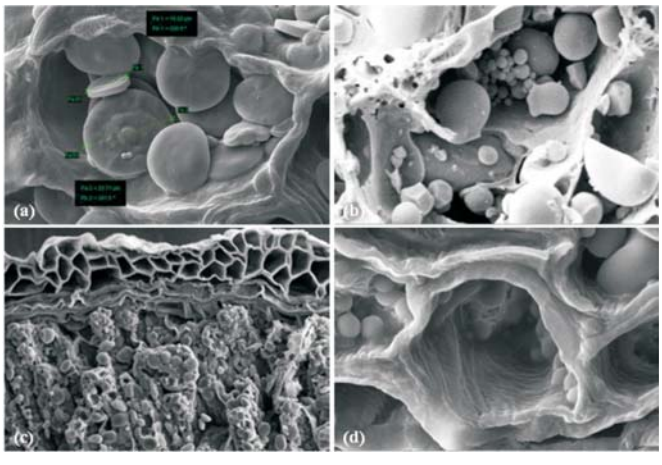
Terminal heat tolerance in wheat

Climate change and abiotic stress affects agriculture and crop production; temperature is one of the most important climatic factors adversely affecting grain yield and quality of wheat. Average wheat yield was observed to be reduced by 4% for every one degree increase in temperature. High-temperature stress (>35°C) during grain-filling has the potential to modify grain-size and quality.

Synthesis of starch and its accumulation in wheat depends on the activity of the soluble starch synthase (SSS) and starch branching enzyme (SBE). Electron microscopic studies of the thermo-tolerant (C 306) and susceptible (PBW 343) wheat cultivars exposed to high temperature (42°C) showed bold and well-defined starch granules with abundant number of endosperm cells in C 306, and small, non-compact and non-spherical granules with lower number of endosperm cells in PBW 343. The problem seems to be associated with the sink, where un-even distribution of starch granules has been observed under terminal heat stress. Identification of sources of heat tolerance for grain-starch content (especially deposition pattern of starch granules in the endospermic cells) in wheat seems to be an important step towards breeding heat-tolerant wheat. Biochemical and molecular studies on the synthesis and deposition of starch granules in different genotypes of wheat may prove useful for adaptation to terminal heat stress.

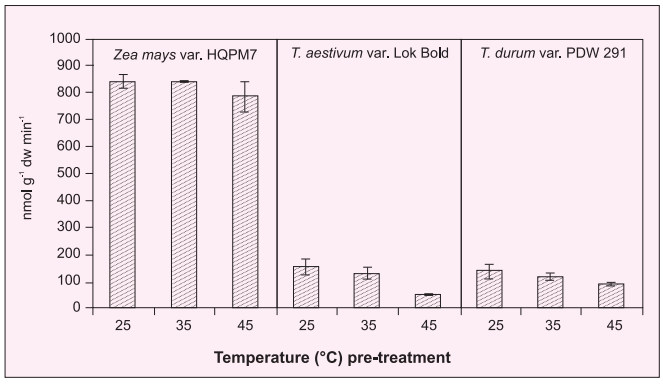


Scanning electron microscopy of seeds of C 306 cultivar of wheat, (*a*) Starch granules synthesized under normal temperature, (*b*) Starch granules in response to heat stress (42°C), (*c*) Structure of aleuronic membrane under normal temperature and (*d*) Aleuronic membrane under heat stress (42°C)



Scanning electron microscopy of seeds of PBW 343, (*a*) Starch granules synthesized under normal temperature, (*b*) Starch granules in response to heat stress (42°C), (*c*) Structure of aleuronic membrane under normal temperature and (*d*) Aleuronic membrane under heat stress condition (42°C)

Decrease in grain growth under high temperature was found to be associated with a decrease in soluble starch synthase (SSS) activity; as this enzyme is extremely sensitive to high temperature. A comparative analysis of



Soluble starch synthase (SSS) activity in the excised grains(20 DAA), following exposure to different temperatures in maize and wheat varieties (Bar represents mean ± SE)

SSS activity in wheat, in a species sensitive to high temperature at grain-filling, and in maize, in a species tolerant to high temperature (~40°C), was made to further understand the phenomenon. It was noticed that maize-grains had remarkably higher (3-4 times higher) SSS activity as compared to wheat. Further investigations revealed a lower Km and a higher catalytic efficiency of maize SSS as compared to wheat. High temperature exposure of excised developing grains did not show any significant decrease in SSS activity in maize, whereas in wheat, a significant decrease of 66.8% was observed. This indicates that an efficient and relatively thermo-stable SSS in maize could possibly be utilized in improving thermo-tolerance for grain-growth in wheat.

Ranjeet Ranjan Kumar* and **Rakesh Pandey****
*Division of Biochemistry
**Division of Plant Physiology, IARI, New Delhi 110 012
e-mail: ranjeetranjaniari@gmail.com; rpandey@iari.res.in

Almonds productivity enhanced under karewa lands of Kashmir

Almond (*Prunus amygdalus*) is one of the important nut-crops of the temperate region of India; grown mainly in Kashmir Valley. It is cultivated over 21,300 hectares with an annual production of 15,620 metric tonnes. Its productivity in the country is very low (0.73tonnes/ha) as compared to other almond- growing countries, USA, Syria and Israel. The main reason for its low productivity is that most of its plantations are on the karewa lands in rainfed areas. The soils of the region are silty loam with poor drainage and receive annual rainfall of about 750 mm, and out of which only 20-25% of the total rainfall is available during the critical stages of nut growth and kernel development. Erratic precipitation and constant droughts due to climate disturbance further reduce almonds productivity potential.

For improving productivity of rainfed almonds, conservation and utilization of rainwater is vital. Many water-harvesting techniques, full moon, half moon, trench and cup-and-saucer along with mulches, were used for trapping and conserving moisture in the rainfed uplands. The maximum nut yield (2.15 tonnes/ha) was recorded in full moon water-harvesting technique + plastic mulch, followed by half moon + plastic mulch (2.04 tonnes/ha), which were 126 and 115 % higher than control; besides moisture conservation of more than 39 and 38 %.

Dinesh Kumar , Nazeer Ahmed and **K.K. Srivastava**
Central Institute of Temperate Horticulture, Rangreth
Srinagar (Jammu and Kashmir) 190 007
e-mail: dircithsgr@icar.org.in

Alkali-halophilic actinomycetes from Chilika lagoon

One-hundred-and-sixteen *Streptomycetes* isolates were procured from Chilika lagoon and sorted out into 59 different morphotypes based on the colour of the aerial and substrate mycelia, pigmentation and microscopic examination. Further screening of the different morphotypes revealed that a total of 21 isolates could be grown at *p*H 9.0 and 1.71 M NaCl (w/v). The Central sector of Chilika lagoon harboured their maximum population frequency (Chadheiguha 28.1% and Nalabana 23%), followed by the South sector (Rambha, 21.2%; Badakuda, 10.53%), while the least population frequency was recorded in the Sea Mouth sector (Manikapatana, 10.32%; Sea mouth, 6.6%). Sediment samples had highest population frequencies than the samples from lake water. Colonization frequencies of alkali-halophilic *Streptomycetes* (*p*H 9.0; NaCl 1.71 M) were shown to decrease from marine habitat to freshwater lake.

Characterization of 21 actinomycetes showed that the South sector harboured the maximum percentage of siderophore producers (48.5%) and the Central sector had highest IAA (45%) and extracellular protease enzyme (45.1%) producers. The Sea-mouth sector was found enriched with nitrate reductase activity (42.3%) organisms and had organisms which showed biocontrol attributes as well (antimicrobial activity (38.8%) as were chitinase enzyme (39%) producers. Chitinase and protease enzyme producing isolates were obtained from the sediment samples while cellular siderophore, IAA, antimicrobial activity and nitrate reductase potential activity isolates were found highest in the water samples.

Catabolic carbon assimilation pattern was also analysed based on the utilization/ non-utilization of 95 substrates, studied by the BIOLOG™ system; all actinomycetes isolates showed different types of carbon-substrate utilization , ranging from 9 to 82 substrates.

Diversity analysis and identification of alkali-halophilic actinomycetes using molecular tools revealed isolates belonging to *Micromonospora echinospora, M.rosaria* and *Streptomycetes albogriseolus, S.acrimycini, S.albus, S.mutabilis, S.thermocarboxydus, S.atrovirens, S.bacillaris, S.geysiriensis, S.achromogenes, S.vinaceusdrappus, S.fradiae, S.macrosporeus, S.griseorubens, S.labedae, S.ghanaensis, S.aureofaciens, S.spiralis, S.erythrogriseus* and *S.fumigatiscleroticus*.

Streptomycetes populations in the different sectors of Chilika lagoon varied considerably in their physiological as well as biochemical profiles, enabling to understand behavioural, ecological as well as their specific substrate requirements in particular brackish niche.

Nityanand Malviya, Mahesh S. Yandigeri, Arvind K. Yadav and **Dilip K. Arora**
National Bureau of Agriculturally Important Microorganismsm, Mau Nath Bhanjan
(Uttar Pradesh) 275 101
e-mail: nbaimicar@gmail.com

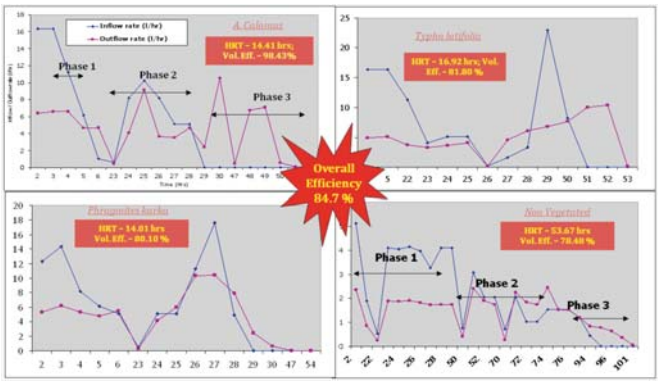
Constructed wetland technology for treating municipal wastewaters

The Indian Agricultural Research Institute, covering an area of 466 ha, is encompassed in a 1,030 ha watershed. Out of the 466 ha, about 290 ha is farmland. About 275ha of the farmlands are irrigated (7.8 MLD) and the rest are under un-irrigated agriculture. And the major sources of irrigation (57%) are groundwater (through 21 tube-wells out of the 33; the remaining used for meeting drinking-water supplies) and canal water (7%, *via* Bhooli Bhatiyari). In the past, about 146 ha-m of canal water per annum was procured. Eventually, due to the development of an extensive underground tank system, which is capable of meeting about 163 ha-m of irrigation demand, the canal water procurement declined to just about 20 ha-m/ annum (or 0.55 MLD). The shortfall in the irrigation demand (2.7 MLD) was partly met through sewage waters, which were generated at an annual rate of 700 ha-m (or 22 MLD). Due to huge costs involved in the procurement of canal waters and a gradual decline in the extractable groundwater supplies to meet irrigation water demands, lately greater interest is developing in remediating huge sewage water supplies for irrigation.

Keeping aforementioned facts, a 1,500-LPD pilot plant, based on the constructed wetland technology, has been developed on the sewage plot site of the Seed Production Unit farms for treating domestic wastewaters of the institute. The pilot plant comprises 18-experimental wetlands/ mesocosms, with 4 replicates of 3 emergent wetland vegetations (e.g., Reed Grass (*Phragmites* sp.), *Acorus calamus* (*Vachh*) and *Typha latifolia*) and 6 replicates of a non-vegetated mesocosms. The sewage waters are by-passed through these sub-surface flow experimental wetlands that are arranged in a CRD design and are periodically monitored for influent/ effluent waters, and soil/ plant samples to assess comparative pollutant removing and volumetric efficiencies of the experimental wetlands to finally recommend an appropriate mitigation strategy for managing poor quality waters.

The wetland treated sewage waters were found to have 76.43% less turbidity and 67% less chromium, 70% less lead, 27% less nickel, 42% less cobalt, 307% less RSC, 25% less fluoride, 51% less nitrate, 38% less phosphate concentrations and 238% enhanced ORP. *Vachh* and *Phragmites* based treatments seemed to be suitable for remediating chloride and carbonate/ bi-carbonate

A Pilot Plant for treating municipal wastewaters of the IARI



Volumetric efficiency and hydraulic retention time of wetland systems

stresses, respectively. In general, *Typha* based systems were found to have far superior nutrient and metal reduction efficiencies than *Phragmites* and *Vachh* based systems.

The developed wetland system was also observed to be have an overall volumetric efficiency of 84% ,and with *Acorus calamus* based wetlands, volumetric efficiency (98.03%) was far superior to *Phragmites* (80.10 %), *Typha latifolia* (81.80%) and unplanted systems (78.48%). The impact of the untreated and treated sewage water irrigations on the quality of produce from wheat and paddy fields was also assessed that showed significantly (2-3 times) lower metal concentrations in the foodgrains produced from wetland treated sewage waters.

Sustainability of the developed wastewater treatment system and a hypothetic Sewage Treatment Plant (STP) was also compared through emergy analysis. Analysis

Emergy Indices	Wetlands	STP
Emergy Yield Ratio	0.70	0.01
Environment Loading Ratio	1.37	42.19
Renewable Percentage	0.54	0.02
Emergy Sustainability Index	0.51	0.00034

Emergy analysis of treatment—Wetlands vs. conventional sewage treatment plant (STP)

showed that the batch flow wetland systems, associated with higher use of local resources and having very small ecologic footprint were far more sustainable than conventional STPs. The OPEX (viz. maintenance and electrical energy expenditure), over 20-year timeframe for the wetland system was also observed to be just $1/100^{th}$ of the conventional STPs. Thus zero sludge, lower cost and higher use of local resources in the constructed wetland technology make it a promising wastewater treatment technology.

Ravinder Kaur, Gaurav Dhir, Paritosh Kumar, Gitla Laishram, Deepa Ningthoujam and **Praveen Sachdeva**
Division of Environmental Sciences, IARI
New Delhi 110 012
e-mail: rk_home@yahoo.com

Harvesting platform for mango and sapota

A hydraulically-operated three-wheel self-propelled elevator harvesting system was designed and developed for harvesting mango, oranges and oilpalm. The unit can be rotated at 360° and has hand-controls on the platform, self-steering mechanism, and 11-hp petrol-engine as a prime mover. The platform could be elevated up to 20 feet (6.07 m) from the ground level. The machine is suitable for operations in the medium height orchards.

V.K. Bhargava* and **A.K. Roul****
Central Institute of Agricultural Engineering
Nabi Bagh, Berasia Road, Bhopal
(Madhya Pradesh) 462 038
e-mail: vinodkbhargav@gmail.com;
ajaykroul@gmail.com

Fish Karyome – database for karyological information

Fish Karyome (Indian fishes karyological information network) database developed contains karyological information of Indian fishes, and enables quick sharing of karyological information on fish species in addition to physical and phenotypic informations among researchers via internet. The database provides information on the chromosome number, morphology, sex chromosomes and cytogenetic markers, like nucleolar organiser regions, constitutive heterochromatic bands etc. in addition to phenotypic information and contains 377 records of 168 species belonging to 43 families and 10 orders. The open access database has high applicability for interspecies/ intraspecific characterization on the basis of cytogenetic/ molecular cytogenetic data of Indian fishes. Such an integrated platform can serve as a baseline dataset for further research, and can also bridge gap between fish cytological information and species identification. SQL Server 2008 used as backend and front end of the database has been designed using Dot Net Technology (ASP.NET-2008) with Flash. The database is accessible at the URL: http://203.190.147.152/.

National Bureau of Fish Genetic Resources
Canal Ring Road,Dilkusha, Lucknow (Uttar Pradesh) 226 002
e-mail: director@nbfgr.res.in

National Bureau of Plant Genetic Resources, New Delhi

Mandate: To act as a nodal institute at the national level for acquisition and management of indigenous and exotic plant genetic resources for food and agriculture, and to carry out related research and human resource development for sustainable growth of agriculture

The National Bureau of Plant Genetic Resources is a premier institute under the Indian Council of Agricultural Research addressing all management issues related to plant genetic resources (PGR); the basic raw material for plant breeding and crop production. The institute is also vested with the authority to issue Import Permits and Phytosanitary Certificates, and conduct quarantine checks on all seed and planting materials (including transgenics) introduced from abroad or exported for research.

The Bureau's headquarters is located at New Delhi with an experimental farm at Issapur (about 45-km away) and 10 Regional Stations located in different agro-ecological/phyto-geographical regions. At the headquarters, Bureau has four Divisions, two units and five cells. Besides this, a National Research Centre on DNA Fingerprinting and an All-India Coordinated Research Project on the Under utilized Crops are also located at the Bureau. The four Divisions – Plant Exploration and Germplasm Collection, Plant

The NBPGR is designated as a "*Centre of Excellence for In Vitro Conservation and Cryopreservation of PGR*" by the Bioversity International and the ICAR. Under this, more than 100 participants from 40 countries were trained.

Genesis

Dr B.P. Pal in his classic paper, *A search for new genes* (1937), expressed the need for an organization for plant introduction and germplasm augmentation for crop improvement. In 1946, an ICAR scheme, 'Plant Introduction' was started in the then Botany Division of the IARI, and later in 1961, a separate Division of Plant Introduction was developed. Subsequently, on the recommendations of the 'High Level Committee' constituted in 1970, the 'Division of Plant Introduction' was upgraded to an institution, 'National Bureau of Plant Introduction' in August 1976 to exclusively deal with PGR activities, and in January 1977, this was rechristened as the National Bureau of Plant Genetic Resources.

Objectives

- To plan, organize, conduct and coordinate exploration and collection of indigenous and exotic PGR.
- To undertake introduction, exchange and quarantine of PGR.
- To characterize, evaluate, document and conserve PGR and promote their use in collaboration with other national organizations.
- To develop information network on the PGR.
- To conduct and promote basic, strategic, applied and anticipatory research for development and management of genomic resources.
- To conduct research, undertake teaching and training, develop policy guidelines and create public awareness on the PGR.

Quarantine, Germplasm Evaluation and Germplasm Conservation and two Units – Germplasm Exchange and Tissue Culture and Cryopreservation Unit address various facets of germplasm collection, exchange, quarantine, characterization, evaluation, distribution, conservation and documentation.

INFRASTRUCTURE

Infrastructural facilities and research at the Bureau have been strengthened manifold since 1985. In November 1996, the new genebank building along with its most modern facilities was inaugurated and was notified as the National Genebank. Medium-term germplasm storage modules were installed and made operational at the regional stations located at Hyderabad, Jodhpur, Shimla, Bhowali, Akola, Thrissur and Shillong. The network of 10 regional/base centres and linkages with the national active germplasm sites (NAGS), got constituted collectively forming the Indian National Plant Genetic Resource System. There are at present 59 crop-based institutes including AICRPs that have been declared as NAGS. A project on the National Containment/Quarantine Facility for testing 'Transgenic planting material' has been made operational which has resulted in the development of a CL-4 level containment facility for quarantine of transgenic planting material. In the XI Plan, a 'National Genomic Resource Centre' was established for the conservation of genomic resources of all agro-biodiversity.

Plant Germplasm Registration

The ICAR has constituted a **Plant Germplasm Registration Committee (PGRC)** under the chairmanship of Deputy Director General (Crop Sciences). The Bureau is entrusted with the responsibility for its implementation. Till date, 24 meetings of the PGRC have been held, and a total of 1,030 trait-specific genetic stocks in 186 crop-species have been registered and conserved at the NGB and NAGS.

PGR Policy Unit and IPR Cell. Although most countries are interdependent for PGR for their research needs, sharing of genetic resources is governed by many international and national legal treaties and laws, especially after the signing of the Convention on Biological Diversity (CBD) in 1993 and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) in 2004. A PGR Policy Unit and IPR Cell at the NBPGR was created to address the emerging issues in the changing paradigm by providing relevant technical inputs to ICAR and various other Ministries for framing appropriate policy and guidelines essential for implementation of laws and policies

National Genebank

The Genebank ranks third largest in the world

The Indian National Genebank (NGB) was established to conserve seeds, vegetative propagules, tissue/cell cultures, embryos, gametes etc. The NGB facility commissioned in 1996 has built-in cold storage modules for conservation of seeds of orthodox species after drying them to 5-7% moisture. Its collections are conserved as base collections (long-term storage) in 12 storage modules maintained at –18°C; active/working collections (short- to medium-term storage) in 5 modules maintained at 4-8°C and 35-40% relative humidity. Vegetatively and clonally propagated and non-orthodox seeded species are conserved in field genebanks and backed-up by *in vitro* and cryopreservation facilities.

The NGB facility is one of the largest with a capacity to hold nearly 0.75 – 1 million base collections. The present germplasm holding of around 0.40 million belonging to nearly 1,800 species is the largest genetic wealth conserved as *ex- situ* collection after China and USA.

Variability in rice, *ber*, gourd, melon, cucumis and beans (anticlockwise)

New Initiatives

- Generation of genomic resources for tolerance to abiotic and biotic stresses and nutritional quality
- Allele mining in priority crops to enhance utilization
- Developing low-input methods for seed conservation and cryobanking of selected vegetatively propagated species.
- Digitization of all herbarium specimens
- Development of eco-friendly salvaging treatments for imported germplasm

ICAR - DRDO Collaboration for the National Permafrost Facility for Conserving PGRA

Memorandum of Agreement (MoA) for conservation of PGR in a National Permafrost Repository at Chang-La, Leh, Ladakh (Jammu and Kashmir) was signed between the ICAR and the Defence Research and Development Organization (DRDO) on 23 August 2011. The high-tech permafrost facility would ensure storage of duplicate samples of elite germplasm from the NGB, at –4 to –20°C temperature with 10-20% moisture. Only one other permafrost storage facility, the 'Svalbard Global Seed Vault' exists in the world, located on the Norwegian island of Spitsbergen.

relevant to PGR management and Biosafety/biosecurity issues. It facilitates submission of applications for plant varieties registration with the Protection of Plant Varieties and Farmers' Rights Authority. It also facilitates in filing of patent and copyright applications, developed by the NBPGR scientists.

SALIENT ACHIEVEMENTS

- Collection of over 2.57 lakh germplasm accessions (86% cultivated and 14% wild) of more than 2,000 species of various crops.
- Since 1976, more than 24 lakh samples of different crops were imported from 103 countries; including 537,425 germplasm accessions and 1,935,411 samples of international trials/ nurseries from the CGIAR centres.
- Over 6.5 lakh samples were exported to research organizations after quarantine processing.
- *Ex-situ* samples stored in seed genebank are more than 3.89 lakh, representing 1,584 species.
- Germplasm accessions totalling 2,082 of 132 species have been conserved for over 6-20 years using *in-vitro* methods, and 9,869 accessions have been cryopreserved in the form of embryos/ embryonic axes, seeds, dormant buds and pollen.

National Herbarium of Cultivated Crops

The institute houses a unique National Herbarium of Cultivated Crops (NHCP). At present, it holds 20,767 herbarium specimens belonging to 264 families, 1,456 genera and 3,919species, and 2,946 seed samples and 621 economic products. The herbarium acts as a source for authentication / identification of new collections of material and for many taxonomic and biosystematic studies.

PGR for Climate Resilient Agriculture

Under the 'National Initiative on Climate Resilient Agriculture' (NICRA) of the ICAR launched in 2011, NBPGR was awarded a research project on 'Acquisition, evaluation and identification of climate resilient wheat and rice genetic resources for tolerance to heat, drought, and salt stresses'. Wheat and rice germplasm have been collected/ screened for abiotic stresses for stable donor parents aimed at developing resistant/tolerant varieties. Some 21,822 accessions of wheat (*Triticum aestivum, T. dicoccum* and *T. durum*) were grown at the CCS Haryana Agricultural University (CCSHAU), Hisar, Haryana, in *rabi* 2011 to characterize for agro-morphological traits and to develop core sets of wheat germplasm to be conserved in the National Genebank. Simultaneously, another set of the same accessions of wheat is grown at Issapur Farm, for evaluating wheat germplasm for heat and drought tolerance. Some 20,660 accessions of wheat (common to the above set) were also sown at the IARI Regional Station farms, Wellington, Nilgiris, Tamil Nadu (hot spot for rust diseases) for screening against rust and other foliar diseases. Germplasm explorations were carried out for collection of rice suitable for extreme climatic/ edaphic conditions. These comprise wild germplasm of *Oryza nivara* (for grassy stunt virus tolerance) and *O. rufipogon* (for submergence tolerance), drought and cold tolerant rice. In collaboration with the All India Coordinated Research Project (AICRP) on Chickpea, about 18,800 accessions of chickpea have been grown at the centre of the AICRP on Chickpea at the Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra, for evaluation. Simultaneous evaluation and screening of such a large number of germplasm is being carried out for the first time. Similar programmes are being designed for pigeonpea and oilseeds.

- About 1.81 lakh active germplasm accessions of various crop-plants have been characterized and evaluated for a set of minimal descriptors (developed for all major crops in the Bureau). More than 19,000 accessions of different crops (including medicinal and aromatic plants) have been evaluated for quality traits. In all, 87 catalogues on 45 crops have been published; 46 catalogues are in electronic form.
- Protocols for DNA fingerprinting using different molecular marker techniques have been developed for 33 crops of national importance. More than 2,215 varieties in different crops have been fingerprinted, and Crop DNA Fingerprint Database has been developed.

THRUST AREAS

Germplasm management is a gigantic task, particularly in the context of the richness of genetic resources and agro-ecological diversity in the country. Some important thrust areas of the research include the following:

- Rationalization of the National Genebank collection and harnessing natural environment for cost-effective conservation.

Human Resource Development

Over the years training programmes to develop Human Resource have been conducted on scientific procedures for exploration and collection, exchange, quarantine, biosecurity, biosafety, DNA fingerprinting, evaluation, documentation and conservation of PGR. About 200 training courses aimed at capacity-building of the NARS partners were organized. More than 500 student-trainees from various educational institutions across the country worked in various Bureau laboratories for 3-6 months project work on biotechnology during the past one decade.

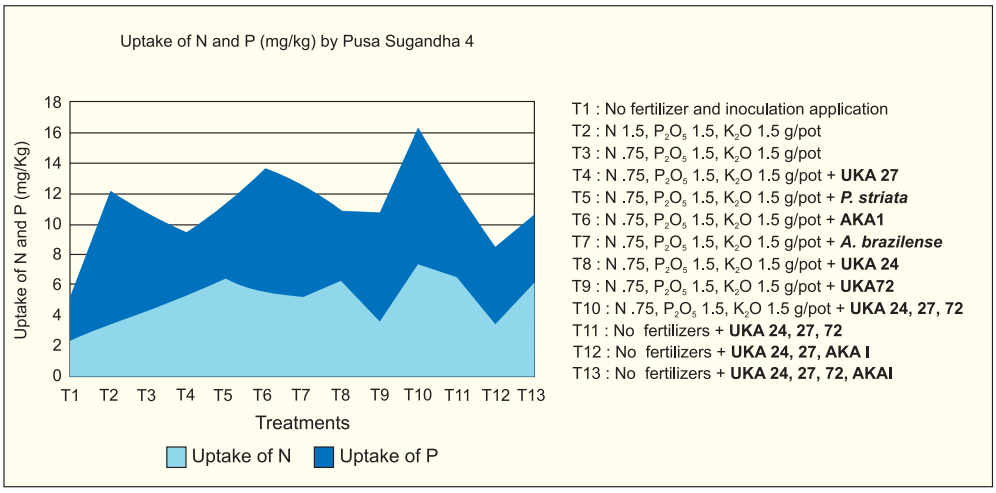
Since academic session 1997, Bureau is undertaking teaching in PGR leading to M.Sc. degree linked with Post Graduate School, IARI, New Delhi. From the academic session 2004-2005, a Ph.D. degree programme in PGR was also started So far, a total of 37 M.Sc. and 10 Ph.D. degrees have been awarded in PGR discipline.

- Collection in partnership mode, trait-specific germplasm for tolerance to biotic and abiotic stresses and quality characteristics.
- Taxonomic and biosystematic studies of Indian taxa using morphological and molecular tools.
- Documentation and mapping of PGR diversity using Geographical Information System (GIS).
- For introduction of plants from abroad, emphasis would be given to trait-specific germplasm of different field and horticultural crops with export potential.
- A national database on potential quarantine pests for an effective pest-risk assessment will be developed.
- Detailed evaluation of conserved germplasm, establishment of core and mini-core of large germplasm collection, identification of potential donor germplasm for agronomic, stress-related and quality traits to increase their utilization
- Commissioning of the National Genomic Resources Repository, genomic resource generation and conservation.
- Development of a functional National PGR database.

K.C. Bansal, Anuradha Agrawal and **Sunil Archak**
National Bureau of Plant Genetic Resources
Pusa Campus, New Delhi 110 012
e-mail: director@nbpgr.ernet.in

Microbial consortium for increased nutrient uptake from basmati-rice rhizosphere

India produces more than 70% of the total world's Basmati rice. The increase in domestic and international demand for aromatic rice has increased use of chemical fertilizers for productivity enhancement. However, this may adversely influence aroma, texture and flavour of the cooked basmati rice.



Alternatively to chemical fertilizers, eco-friendly microbial approaches can be used to maintain nutrient quality of the rice. With this aim, bacterial strains from different rice rhizospheres, soils and plant roots, were isolated. Two hundred and twenty-six bacterial isolates were screened for plant-growth promoting (PGP) activities from basmati rice, Pusa Sugandha 4, Pusa Sugandha 5, HBC 19, Super Basmati and Punjab Basmati (IARI fields), and eleven varieties of aromatic rice grown at the Central Rice Research Institute (Cuttack). Out of the total from the IARI paddy soils, 46 % showed *in-vitro* antagonistic activity against plant pathogenic fungi (*Sclerotium rolfsii, Fusarium oxysporum* and *Rhizoctonia bataticola*) and bacteria (*Xanthomonas compestris* pv. *phaseoli* M5, *Xanthomonas oryzae, Xanthomonas compestris* pv. *phaseoli* CP-1-1 and *Ralstonia solanacearum*); 2% were IAA producers, 12% were phosphate solubilizers; and 11% were siderophore and 6% were HCN producers, and of the CRRI rice rhizospheres 40% were ammonia + siderophore producers and 44% were salt (NaCl) tolerant.

A microbial consortium was developed with the most efficient IAA producer, siderophore producer and P-solubilizing strain, and was evaluated under *in-vivo* conditions on Pusa Sugandha 4.These three strains using BIOLOG were identified as *Rhizobium radiobacter* (UKA 24, auxin producing), *Bacillus pumillus* (UKA 27, P-solubilizing) and *Stenotrophomonas maltophila* (UKA 72, siderophore producing). The microbial consortium treated plants showed maximum uptake of P and K as compared to un-inoculated control.

Upendra Kumar[1], Vithal Kumar L[2], Ramdoss D[2], Pranita Bose[2] and **Annapurna K[2]**
[1] Central Rice Research Institute, Cuttack 753 006 (Odisha)
[2] Division of Microbiology, IARI, New Delhi 110 012
e-mail: annapurna96@yahoo.co.in

Polyclonal antibodies for detection of multiple viruses

A cocktail of polyclonal antibodies for simultaneous detection of multiple viruses such as Papaya ringspot (PRSV) and Cucumber mosaic (CMV) viruses in plant samples has been developed.

A fusion construct using conserved coat-protein sequences of CMV (444 nt) and PRSV (528 nt) was developed in an expression vector pET 28a. The fusion protein (~40kDa) expressed in *Escherchia coli* was purified and used for raising antibodies in rabbit. The cocktail antibodies simultaneously detected PRSV and CMV infection in samples of chili, cucurbits, papaya and tomato plants in the DAC-ELISA at 1:500 dilution.

R.K. Jain and **Bikash Mandal**
Division of Plant Pathology, IARI, New Delhi110 012
e-mail: rakeshjain56@yahoo.co.in; leafcurl@rediffmail.com

PCR-based detection system for pomegranate bacterial blight

A rapid and reliable PCR-based detection system for *Xanthomonas axonopodis* pv. *punicae,* the causal bacterium of pomegranate bacterial blight, has been developed. This DNA-based detection system is very specific that amplifies 491 bp region of the pomegranate blight bacterium *gyrB* gene. The protocol requires only 3 hr; involving 60 min. for template preparation from plant tissues, 90 min. for PCR amplification and 30 min. for gel electrophoresis. The detection limit is 10^2 cells/ml as well as 0.1 ng of template DNA/ µl. The system has been validated by the inter-institutional team of scientists using bacterial blight affected field samples.

The kit would facilitate detection of pathogen in planting materials and would help in confirming pathogen identity.

K.K. Mondal
Division of Plant Pathology
Indian Agricultural Research Institute
New Delhi 110 012
e-mail: mondal_kk@rediffmail.com

Vegetable farming in drought-hit Manipur village

In the Ngairangbam Mayai Leikai village of Imphal West district in Manipur, farmers suffered heavy losses due to drought during rainy season (*kharif*) 2009. Shri Chanam Kameshwar Singh (42 years), a poor paddy farmer, lost his paddy-crop due to drought. He had lost his entire crop before the onset of the rains. He approached the ICAR Team that suggested him for growing of early cauliflower variety Himlata, followed by medium cauliflower variety White Flash and late variety Candid Charm in his small 2,500 m^2 field. He was given necessary technical know-how for how early quality seedlings can be produced to grow off-season cauliflower. Critical inputs such as seed, pesticides, fertilizers and small farm tools were also supplied by the Horticulture Mission. Within a short period of two months, he could earn a profit of ₹14,500 from his plot by selling the produce from Himlata. After harvesting cauliflower Himlata, he immediately transplanted White Flash. By the middle of December, he started harvesting the crop and earned a sum of ₹30,190. In the middle of November, he transplanted late season variety Candid Charm, and by the first week of March, he earned ₹25,000. From his profit, he purchased a 6.5-hp water-pump along with its accessories to support his farming. He also started earning ₹500/day by lending his water-pump.

The farmer not only reaped good harvest but was also convinced that vegetable farming is remunerative. At present, he has become a dedicated vegetable grower and has also purchased a power tiller. His success created an impact among other farmers, and now they have found a better source of income through vegetable farming.

S.S. Roy, A. Rajlakshmi Devi, P.K. Sharma
and **N. Prakash**
Manipur Centre, Lamphelpat
Imphal (Manipur) 795 004

White mushroom strain of *Volvariella volvacea* identified

Paddy-straw mushroom (*Volvariella* spp.) cultures obtained from different sources were screened for morphological growth characteristics on the Malt Extract Agar and on the pounded paddy-straw in culture-tubes for selecting promising strains. The strains were also identified on the molecular basis using PCR amplified sequences of the ITS region of 5.8S rDNA.

The strains were grown using composted substrate of paddy-straw and cotton-ginning mill-waste (1:1w/w) and pasteurized paddy-straw. The identified white strain gave earliest fruiting in 12 days from spawning and the highest yield of 25.79 kg/100 kg of the dry composted substrate. On the pasteurized paddy- straw, the same strain gave fruiting in 12 days after spawning and yield of 18.45 kg/100 kg of the dry paddy-straw. Its average fruiting-body weight was 20.74 g on the composted substrate of paddy straw + cotton-ginning mill waste, and was 11.73 g on the pasteurized paddy-straw. The number of pinheads formed/bed were more on the

pasteurized paddy-straw based substrate than on the composted substrate. This strain has a potential to replace the existing stocks as it gave good yields, and can fetch higher price in the market because of its superior colour and better fruiting-body.

Directorate of Mushroom Research
Chambaghat, Solan (Himachal Pradesh) 173 213
e-mail: ahlawat22op@gmail.com

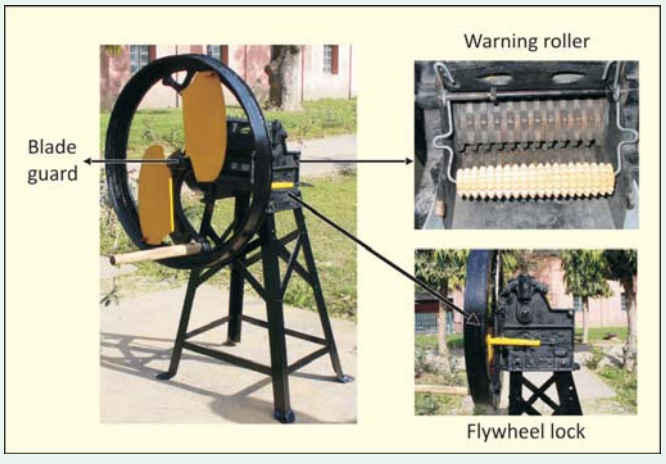
Safety interventions for chaff-cutter

Chaff-cutter is a unique agricultural equipment, which is used throughout the year. Every rural household, irrespective of their socio-economic status that has cattle, keeps chaff-cutter, which is usually operated twice daily depending upon the number of cattle. Any member of the family, including children operates the machine. The severities of injuries with the cutter are usually high, as it has sharp blades and feed rollers. Inadvertently, body parts coming in contact with the blades may amputate. Similarly hands getting trapped between the serrated power rollers may have crushing injury.

A cost-effective safety intervention that could be retrofitted on the old as well as on the new machines was needed.

Safety devices

Following Interventions have been developed for the safety of the manually as well as the power-operated chaff-cutter.



To understand the mechanism of the injury, a field survey of five villages Sadarpur, Matiala, Kanoja, Morta and Shikrora of Razapur Block in Ghaziabad district was conducted.

Causal factors for injuries

Entrapment of hands in feeding rollers during feeding of fodder in the machine; Loose clothes, getting entangled in the gears and belt; Unstable platforms; Fluctuation in the speed of prime mover that results in a sudden change in roller speed.

Blade guard: It consists of a metal guard made up of mild steel sheet and can be attached to two existing blade bolts. It can be opened for sharpening blade.

Flywheel lock: It is a spring loaded mechanical lock that prevents rotation of the flywheel in a standby mode.

Warning roller: It consists of a serrated wooden roller that warns when the hand is in danger zone while feeding chaff-cutter.

Efficacy of the devices: The developed interventions gave encouraging results when tested in the field conditions.

D.V.K. Samuel, Adarsh Kumar and **J.K.Singh**
Division of Agricultural Engineering, IARI
New Delhi 110 012
*e-mail:*dvksamuel@yahoo.com

Value-Addition of flowers for economic advantage to farmers

Floriculture in India is mainly for growing traditional flowers for garland-making, worship and floral decorations. Nearly 182,000 hectares are under traditional flowers' cultivation to provide as much as 102,000 metric tonnes of loose flowers.

A large number of small and marginal farmers are involved in the cultivation of the traditional flowers — rose, chrysanthemum, marigold, crossandra and tuberose. And very often flower prices crash in the market due to their demand-supply situation, thus forcing farmers to sell produce in distress, which sometimes even does not cover their harvesting and transportation cost; resulting in considerable losses to farmers. To convert excess flower production or market

General precautions for drying

To get the best quality products, following precautions should be taken care of while collecting plant material and for drying them: Collect fresh material; Material should be collected after dew/moisture has evaporated (i.e. in the day-time);Material should be collected from the field 2-3 days after watering; Collect all stages of flower development. Inflorescence should be collected which has sufficiently hardened as immature one shrivels fast; Embed or press material immediately after plucking; Different type of flowers or foliage should be dried separately; and cut all undesirable portions before embedding.

Photoframe

surplus into value-added products, technologies have been developed for different flowers.

Marigold drying. French marigold variety Pusa Arpita has a potential to produce 20-22 tonnes of flowers /ha. Attractive, compact, orange, medium-sized flowers are found suitable for making value-added dry-flower products like containers, greeting cards, photoframes, bookmarks etc. For three dimensional value-added products, embedded drying technology was standardized for this variety. Flowers are embedded in the river-sand and then kept for shade-drying at room temperature for a week to retain their original shape and colour.

Chrysanthemum drying. Drying technology has been standardized for chrysanthemum varieties like Vasantika, Gauri, Maghi White and Jayanti. Freshly harvested flowers are embedded in silica-gel and are then dried in hot-air oven at 45°C for 48 hours, which was ideal for Vasantika, Gauri and Jayanti, and for cv. Maghi White, drying in microwave oven for 90 sec was promising.

Annual chrysanthemum (*Chrysanthemum coronarium*) is gaining popularity in the recent times in the northern India. It is the second most important loose flower-crop grown after marigold. Researches on the annual chrysanthemum have yielded a number of promising

Dry rose arrangement

lines in the pipeline for release. White and yellow cultivars are being dried by embedding them in the silica-gel and drying at 40°C for 48 hr in hot-air oven for retaining floral morphology and colour, to be used for making value-added products.

Crop-specific drying technologies

Annual crop	Technology
Calendula	Press-drying of flowers in microwave oven for 90 seconds
Marigold	Press-drying of flowers in microwave oven for 120 seconds
Larkspur	Press-drying at 40°C in hot-air oven for 24 hours
Pansy	Press-drying of flowers in microwave oven for 100 seconds
Poppy	Press-drying of flowers in microwave oven for 90 seconds

To bring awareness, frequent training programmes are organized, especially for farm-women of the adopted villages in Haryana and NCR region, to impart skills on value-addition, for converting farm surpluses to wealth. The dried flowers and also the leaves are converted into photo-frames, greeting cards, bookmarks, paper weights for earning additional income.

Ritu Jain and **T. Janakiram**
Division of Floriculture and Landscaping
Indian Agricultural Research Institute, New Delhi 110 012
e-mail: headflori@yahoo.com

Safety attachment to palm-climbing device

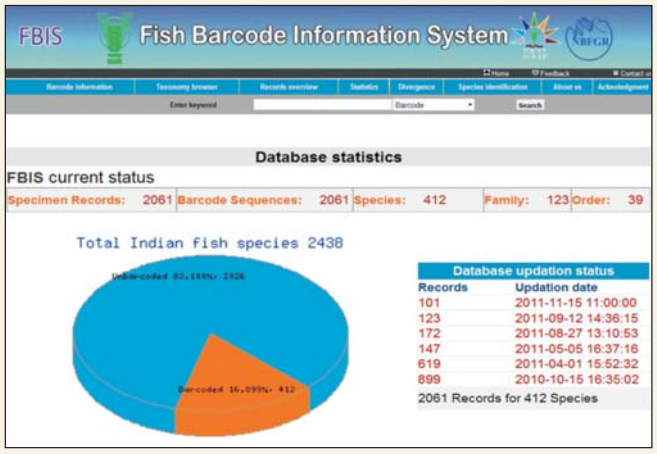
For proper safety of coconut / palm-tree climbers, existing commercially available Chemberi coconut / palm climber has been modified. A simple cost-effective device, fitted with a rope, tightens it with the plant as a safety harness worn by the climber, and remains in a locked state in case the climber accidently begins to fall. A positive locking for Chemberi (SS) model has also been provided to lock the machine to the tree trunk to facilitate ascend or descend of the climber from the crown to the device to help him clean coconut-crown. The new device enables climber to remain hanged in the safety harness in case of a slip and can make him regain his/her position in a few seconds without assistance of any other person. This reduces height fear and eliminates risk of falling down. The device was successfully demonstrated at the Central Plantation Crops Research Institute, Kasaragod.

H.L. Kushwaha and **Dushyant Singh**
Central Institute of Agricultural Engineering
Nabi Bagh, Berasia Road, Bhopal
(Madhya Pradesh) 462 038
e-mail: hlkushwaha@gmail.com;
dsciae@gmail.com

Fish Barcode Information System

The **'Fish Barcode Information System' (FBIS)** for Indian fishes was conceived and developed under the National Agricultural Bioinformatics Grid(NABG) Project, which is first of its kind in India. It is a new platform to assist and manage acquisition, storage, analysis and exploration of DNA barcode records of fishes for resolving taxonomic ambiguities, species identification and molecular genetic analysis. This database contains sequence information on Cytochrome *c* oxidase I (COI) mitochondrial gene for 412 Indian fish species comprised with 2061 NCBI Accessions, along with their morphology, distribution and their IUCN Red List status.

The FBIS system has been developed on the Red Hat Linux Enterprises using Perl and PHP as programming languages and MYSQL as database management system in the backend. The web version of the FBIS incorporates browser interfaces, facilitating statistics, taxonomy applications, species identification and sequence diversity estimation at taxon and at sub-taxon levels. The FBIS comprises interspecific and intraspecific DNA barcode records of fishes collected from different water-bodies of India, and enables fish species identification systematically with consideration of geographical location, and thus complements existing DNA barcode sequence database like FISH BOL. It is anticipated that this platform would be useful as an appropriate identification system for conservation and management of Indian fish diversity. The database can be accessed at the URL: http://203.190.147.148/fbis/.



National Bureau of Fish Genetic Resources
Canal Ring Road, Dilkusha
Lucknow (Uttar Pradesh) 226 002
e-mail: director@nbfgr.res.in

Status of milk production in India

The total domestic demand of milk is expected to be 209 million tonnes by 2026-27, from 116.3 million tonnes of 2011-12. Out of the 209 million tonnes of milk, 123.6 million tonnes would be required for

World's first ETT Mithun-calf

The world's first-ever embryo transfer mithun-calf, christened Bharat (male), is born at the National Research Centre on Mithun of the Indian Council of Agricultural Research (ICAR), Jharnapani, on 27 March at 4:50 pm. The historic experiment was performed by a group of scientists led by Drs Kishore Kumar Baruah, Mohan Mondal and Chandan Rajkhowa. The other members of the ETT (Embryo Transfer Technology) team includes Drs BC Sarmah, BC Deka, DJ Dutta, P Chakravorty and Bhaskar Bora.

www.nrcmithun.res.in

household consumption and 85.4 million tonnes would be indirect demand. The earlier demand projections for 2020 based on the assumption of higher growth varied from 183 million tonnes to 247 million tonnes. In 1998, milk demand was projected at 182.8 million tonnes, subject to an annual average growth rate of 7 % in GDP. Milk demand projections in 2001 for 2020 were 246.4 million tonnes under the scenario of the high demand for livestock products. Within milk and milk products, change seems to be tilted in favour of high-value milk processed products like ice-creams.

Demand projections for milk in India

(million tonnes)

Year	Household demand	Indirect demand	Total demand
2011-12	68.8	47.5	116.3
2016-17	81.7	56.4	138.1
2021-22	99.4	68.7	168.1
2026-27	123.6	85.4	209.0

An important question now is whether the expected milk supply would meet the growing domestic milk demand in India. To meet the projected demand, India needs to maintain an annual growth rate of 3.7 % in milk production. The supply projections under different scenarios indicate that with the existing growth rate of milk production during the previous decade, India would continue to remain self-sufficient in milk even in 2026-27. And any slow down or deceleration in milk production growth would jeopardize self-sufficiency status of milk production in the country. However, if concentrated efforts are made to accelerate growth of milk production, India can turn out to be an important exporter of milk and milk products. The rising milk demand in India has implications for broad international milk market. If India falls short of meeting its domestic need, what will be the impact on the prices of dairy products in India as well as different world markets? How much India will need to import? These issues deserve urgent attention from India and from the broader international agribusiness community. The productivity-led growth is the only viable option for an accelerated sustainable growth of the Indian dairy sector. Several avenues and strategies for policy intervention to support dairy development for enhanced milk production and productivity have to be explored. Besides continued investment in improved breeds of cattle and buffalo, the strengthening of market linkages either through expansion of cooperatives, or facilitating contract farming arrangements would go a long way in accelerating milk production growth in the country.

Prospects of future milk production in India

(million tonnes)

		Compound annual growth rates		
Year	Existing growth rate	3%	4%	5%
2011-12	120.6	119.7	120.8	122.0
2016-17	145.4	138.7	147.0	155.7
2021-22	175.3	160.8	178.9	198.7
2026-27	211.4	186.5	217.6	253.7

Dr Anjani Kumar
Principal Scientist (Agricultural Economics)
National Centre for Agricultural Economics and Policy Research, New Delhi 110 012
e-mail: anjani@ncap.res.in

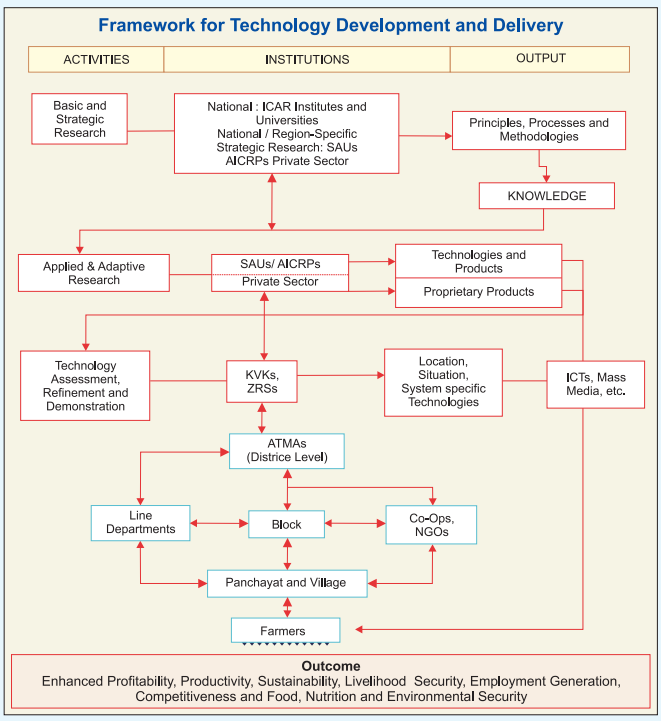
Published by Dr T.P. Trivedi, Project Director, Directorate of Knowledge Management in Agriculture, Indian Council of Agricultural Research, New Delhi 110 012. *Phone:* 011-25842787; *Fax:* 011-25843285, *e-mail:* tptrivedi@icar.org.in. Lasertypeset by M/s Print-O-World, Shadipur, New Delhi 110 008, and printed in India at M/s Royal Offset Printers, A-89/1, Naraina Industrial Area, Phase I, New Delhi 110 028.

Editing : **Dr R.P. Sharma and Shashi A. Verma** ***Design & Production :*** **Dr V.K. Bharti and Punit Bhasin**

WAY FORWARD

THE ICAR and the State Agricultural Universities have given a major thrust to agricultural extension in the country, primarily by the frontline technology application through Krishi Vigyan Kendras; at present there are 630 KVKs in all rural districts across the country. The Krishi Vigyan Kendras are basically engaged in technology assessment, refinement and demonstration at the district level. The technology application has also been through National Demonstrations (NDs), Operational Research Projects, Lab-to-Land Programme, Institution Village Linkage Programme, and Agricultural Technology Information Centre (ATIC). Agricultural Technology Management Agencies (ATMA) model was also developed and tested in 28 Districts of the country under the NATP, and this is now replicated in 604 districts by the Department of Agriculture and Cooperation, Ministry of Agriculture. At the district level, the ICAR through KVKs has established coordination with ATMAs to strengthen research-extension-farmer linkages.

Innovation generally steers development, but knowledge and skill too have become crucial and integral components for the innovation to accelerate agricultural growth. In this context, farmers need to be connected



with agri-business, production systems, research institutions, public administration, other farmers, domestic and global markets and diverse partners. The conventional systems of dissemination of farm information through face-to-face communication by extension and development functionaries and through printed publications and agricultural exhibitions are becoming limited propositions. To offset this, in extension, a holistic *Framework for Technology Development and Delivery System* as a continuum has been suggested by the ICAR.

Dr S. Ayyappan, Secretary (DARE) and Director General (ICAR)

The institutional linkages in the framework may vary depending upon the nature of the crop/commodity/enterprise and technology service in involving relevant stakeholders to a specific technology-enabled zone/area/situation. Such linkages will boost production and productivity and would create an enabling environment for substantially enhancing profitability through job opportunities, rural marketing economy and export opportunities.

Farmers are now being considered as partners of the development rather than as end-users of the technology. Realizing this, the ICAR has proposed and conceived 'Farmer FIRST' programme to ensure farmers participation.

The 'Farmer FIRST' aims at enriching farmers-scientists interface for technology development and application. It will be achieved with focus on innovations, feedbacks, multiple stakeholders' participation, multiple realities, multi method approaches, and vulnerability and livelihood interventions. Its primary objective is to take up technology development based on feedback from farmers and landless farmers' participation for enhancing production, productivity, income and equitability by utilizing strength of the technology institution partner.

The strategy for technology development and strategy for technology dissemination are not mutually exclusive. While research-extension linkages were possible in the inter-personal mode, in the new regime, effective linkages of production systems with marketing, agro-processing and other value-added activities have acquired greater importance and thus require blending of the inter-personal mode with Information and Communication Technology (ICT)-mediated approaches. To achieve an inclusive growth, research and extension have to be vibrant to provide enabling environment by focusing on production, profitability and institutional innovations.

(S. Ayyappan)
e-mail: dg.icar@nic.in