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ICAR NEWS

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RESEARCH UPDATE

PROMISING TECHNOLOGIES

Regenerate banana from floral meristems

IIHR, Bangalore. Immature male-flower clusters from 0 to 16 position of banana cultivar Nanjangud Rasbale (Rasthali, AAB) were removed and inoculated on the Murashige and Skoog medium supplemented with 2,4 dichlorophenoxy acetic acid (2,4-D), indole 3-acetic acid (IAA), naphthalene acetic acid (NAA) and d-Biotin, sucrose and

Banana plants hardened for transplanting to field

gelrite for callus induction in dark at 25 ± 2°C and relative humidity of 80%. Petriplates were sealed with parafilm to avoid evaporation and contamination. After 5 to 6 months, cultures producing high proportion of homogeneous fragile embryogenic callus containing

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PROMISING TECHNOLOGIES

translucent proembryos were selected, and under a microscope transferred to liquid medium (MA2) containing 2,4,D. These calli being friable immediately fall apart in the suspension. Conical flasks were shaken in the incubator-shaker at 70 rpm at 25 ± 2 °C in dark. The suspensions were transferred to fresh medium every 10 days by taking 4 ml of original culture and 6 ml of fresh medium. These were grown until a multiplication rate of 1.5 to 2 was reached. Cell growth was determined by taking fresh weight and dry pellet formed by centrifuging 1 ml of suspension. Cell suspensions were plated on to the filter paper for development and maturation into embryos on the media containing vitamins, BAP and IAA (MA 3, MA 4)and cultured at 25±2°C and at a light intensity of 30 µmol^{-2} S^{-1}. Mature embryos were transferred to MA 4 medium from MA 3 medium or allowed to continue on the same medium, and those plated directly on MA4, for germination into plantlets. The germinated plantlets were tranferred to MS medium containing BAP and IAA at relatively higher concentration. When the plants had grown to 7.62 cm with sufficient rooting, they were transferred to hardening medium containing soilrite.

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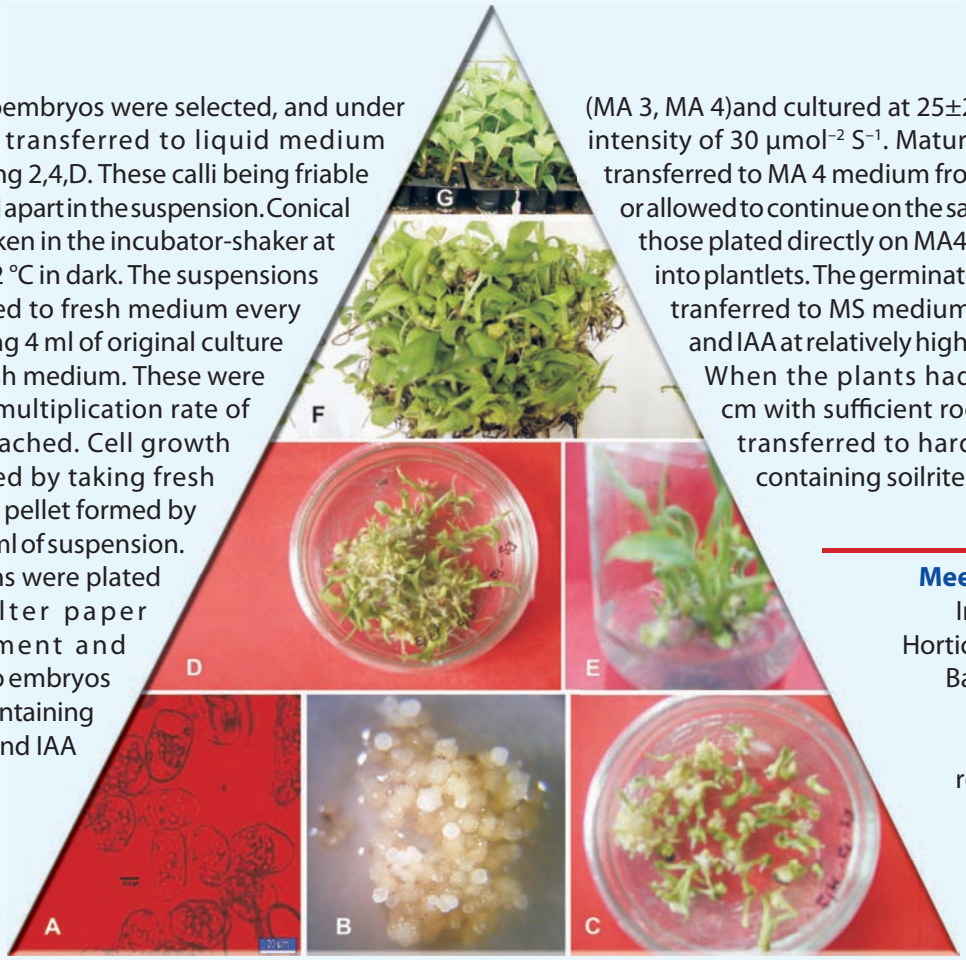

A. Suspension culture of banana cv Rasbale showing single cells
B. Suspension maturing into embryos
C,D. Germinating embryos
E. Shoot and root well established
F. Banana plantlets
G. Banana plants hardened for transplanting to field

Lentil heritable genetic variants for Fe and Zn

IIPR, Kanpur. Lentil seeds are known for high protein content (>25%). Recently, there are reports of heritable variants of lentil for iron and zinc contents. Incorporation of high contents of iron (Fe) and zinc (Zn) in good agronomic background of lentil can help alleviate micronutrient deficiencies widespread among 47% of the children below 5 years of age and 50% of pregnant women in India. Keeping this in mind, a set of 31 lentil genotypes comprising 20 exotic lines (Source: ICARDA) and 11 indigenous genotypes were evaluated. After harvesting seeds, three samples from each genotypes were analyzed for Fe and Zn contents using atomic absorption spectrophotometer.

Genotypes with high Zn content (>50 µg/g) are FLIP 2003-25L, FLIP 84-55L, Acc. 2313, FLIP 2002 56L, NEL 857 and Lenka. And most promising genotypes for high Fe content (> 50 µg/g) are NEL 857, Pant L 5, 81 SI5, FLIP 2002-7L, FLIP 2003-25L, FLIP 86-38L, Acc. 2313 and FLIP 95-55L. NEL 857, Acc. 2313 and FLIP 2003-25L with high contents of both the micronutrients can be used in breeding programmes for bio-fortification of lentil varieties.

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Enhancing spider population in rice fields for managing rice insect pests

NCIPM, New Delhi. In rice fields, spiders constitute over 90% of the natural enemies population, which predates upon a variety of insect-pests, especially planthoppers. Indiscriminate and injudicious use of insecticides by the farmers in the rice ecosystem has adversely affected spiders population over the years.

Straw bundle in rice field (Spider population with straw bundle was 1,530,000)

Field trials conducted during 2006 and 2007 at Atterna (Sonepat-Haryana) with Pusa Sugandh 4 (Pusa 1121) rice have indicated that spiders population can be significantly increased using straw bundles in rice fields.

Straw bundles are prepared with wheat-straw packed in plastic-nets. Each bundle is about 91.4 cm in length and 25.4 cm in diameter. Both ends of these bundles are tied with plastic rope and are placed in the sorghum fields for charging with spiders and other natural enemies. After 15 days of charging, these bundles are fixed vertically with bamboo-sticks at 20 bundles/ha inrice fields with 20 days old transplanted seedlings in such a way that the lower portion of the bundle remains 15.2 cm above the water level. Observations made on charging of the straw bundles indicated that each bundle contained 30-40 spider adults, 8-10 spider egg-masses and 500-600 spiderlings. Validation trial conducted in 2008 at Sobouli (Sonepat-Haryana) indicated a significant increase in the population of spiders by straw-bundle technology that helped reducing brown plant-hopper outbreak.

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Indigenous shrimp feed commercialized

CIBA, Chennai. Shrimp feed technology was developed through formulation of several test feeds using indigenous ingredients to meet dietary requirements of tiger shrimp (*Penaeus monodon*) and Indian white shrimp (*Fenneropenaeus indicus*). The test feeds were first evaluated in the laboratory experiments and then in the yard experiments for developing three grades of feeds–starter, grower and finisher. Feed formulations which gave best growth and good food conversion ratio (FCR) were selected for up-scaling. A pilot-scale feed mill with a Ring-Die pellet mill was set-up at the Muttukadu experimental station of the CIBA for scaling up feed production.

The shrimp feed was produced and tested on tiger shrimp in grow-out ponds in the Kakdwip Research Centre as well as in the farmers' ponds in Andhra Pradesh and Tamil Nadu; and the performance was compared with popular commercial feeds as control. In all trials, shrimp feed performed well, resulting in an excellent growth (28-35 g weight in a culture period of 120-140 days) with a conversion ratio of 1.2-1.8:1. The performance of the shrimp feed in terms of growth and FCR was on a par with that of commercial feeds.

Commercial production of CIBA shrimp feed

The feed mill established by M/s Bismi Feeds Pvt. Ltd based on CIBA feed technology has capacity to produce 3,000 tonnes annually. The investment for feed mill and fishmeal plant along with warehousing facility was Rs 1.5 crore. With a working capital of Rs 1.0 crore, the total investment made in the project was Rs 2.5 crore.

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NEW INITIATIVES

Successfully cryoperserving mulberry dormant buds

NBPGR, New Delhi. For ensuring sustainable development and strengthening of sericulture industry, conservation of *Morus* species of subtropical and temperate regions is a priority area. Being vegetatively propagated, it has been preserved in the field genebank. however, for alternative safe long-term conservation, cryotechnology is the need.

In vitro raised plantlets from 10 months cryo preserved mulberry dormant buds

Field transferred *in vitro* raised mulberry plantlets

Mulberry dormant buds of cold-hardy types were successfully cryo-preserved abroad, mainly in China and Japan. Conservation of mulberry germplasm through cryopreservation of dormant buds was, however, not attempted in India. And for long-term cryopreservation, less cold-hardy mulberry germplasm pose considerable challenge.

To develop a cryopreservation method for using vegetative dormant buds, desiccation sensitivity of the bud-grafts and the excised buds was studied. Nodal stem segements bearing dormant winter buds and excised buds were processed for cryopreservation by step-wise freezing up to –30°C after desiccation between 15 and 25% moisture. On grafting bud-grafts directly on the field-grown plants, survival up to 50% was achieved. This technology is economical and leads to direct regeneration, obviating *in vitro* regeneration. Regeneration of cryostored winter buds under *in vitro* was up to 70-80%. This is the first report of successful cryopreservation of mulberry dormant buds belonging to *M. indica, M. latifolia, M. serrata, M. laevigata, M. australis, M. bombycis, M. alba, M. sinensis, M. multicaulis* and *M. rotundiloba.*

It is noteworthy that buds not subjected to any freezing temperature in fields were found amenable to cryopreservation. Successful cryo-preservation in liquid nitrogen (–196° C) for sustainable use has been achieved using simple protocols for the first time for cold-tender genotypes. Regeneration of cryopreserved mulberry germplasm accessions after 1-3 years of storage indicated no survival loss.

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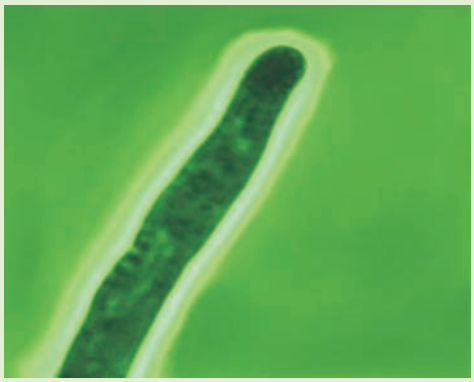
Novel bacterial antagonist for IPM

VPKAS, Almora. *Exiguobacterium acetylicum* strain 1P (MTCC 8706) is a gram positive, rod-shaped, yellow pigmented bacterium isolated from rhizospheric soil of an apple orchard from the North Western Indian Himalayas on the nutrient agar plates incubated at 4°C. The species was identified on the basis of 16S rRNA gene sequencing. The sequence showed 98% similarity with *E. acetylicum*; available in the public domain, and was positive for siderophore and HCN production. It inhibited growth and development of *Rhizoctonia solani*, *Sclerotium rolfsii*, *Pythium* and *Fusarium oxysporum* in

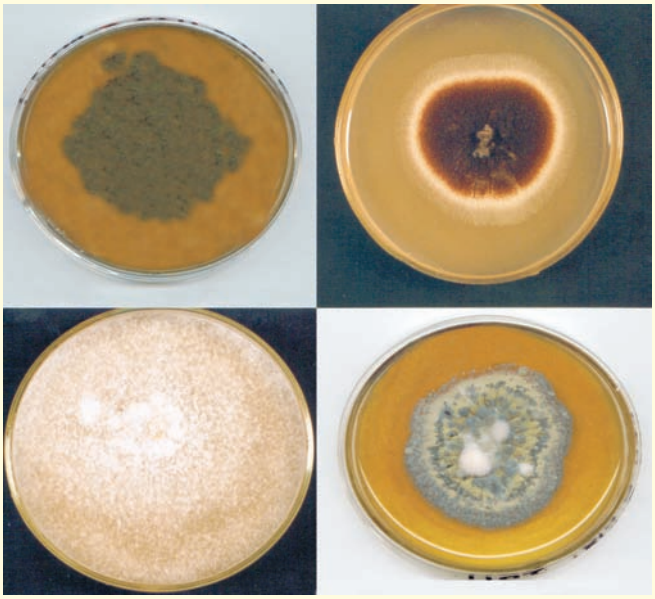


Normal hypha of *Sclerotium rolfsii*

Composting agroresidues with fungal inoculant

IARI, New Delhi. Crop residues available in India are estimated at 600 million tonnes. Rice and wheat are the major crops; generating around 250 million tonnes of residues. In Punjab by applying paddy-straw compost, farmers can add 38.5 lakh tonnes organic carbon, 58,000 tonnes nitrogen, 1,900 tonnes phosphorus, 34,000 tonnes potash and 4,600 tonnes sulphur to soil every year. Decomposing paddy straw is a problem because it contains approximately 40% cellulose, 20% hemicellulose and 12% lignin, and has high C:N.

Several strains of mesophilic and thermophilic microorganisms were screened for utilization of paddy-straw. Four fungi, *Phanerochaete chryso sporium*, *Trichoderma viride*, *Aspergillus nidulans* and *Aspergillus awamori* were identified to carry out solid state fermentation of paddy-straw; and all in combination were the best.



Fungi for preparation of compost inoculant

Inoculum

Inoculum of selected fungi was prepared in sorghum-grains supplemented with $CaSO_4$ (4%).

IARI Compost inoculum

Fungal inoculum of four fungi was developed for composting crop residues. Inoculant is being sold at Rs 20 per packet. A packet of 300g is enough to decompose one tonne of organic matter within 90 days.

Process

Perforated brick-tanks were constructed for proper aeration for the composting of paddy-straw. The straw was supplemented with poultry droppings (8:1) or urea at 0.5% to bring down C: N ratio of the straw. A tank of 1 m^3 can accommodate 80 kg of the straw. Rock phosphate (1%) along with inoculum containing four fungi was applied at 0.5 kg/tonne of straw and mixed in the tank. Moistened paddy with sufficient water. By this technique, compost with C:N ratio of 15:1 can be prepared within 2-3 months.

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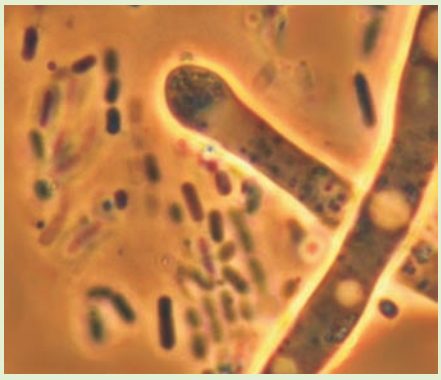

Anagonized hypha with *bacteria*

separate *in vitro* assays. The volatile compound produced by the bacterium was found most potent in inhibiting hyphal development of *Rhzoctonia solani*, *Sclerotium rolfsii*, *Pythium* and *Fusarium oxysporum* by 45.55, 41.38, 28.92 and 39.74%. Commonly observed deformities caused by the diffusible-and-volatile compound include hyphal inhibition, constriction and deformation. It has showed potential to be an important component of the IPM.

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NATURAL RESOURCES MANAGEMENT

Cryopreserved banana fruits in Delhi

NBPGR, New Delhi. As the primary centre of origin of cultivated banana, India has an immensely diverse genepool of *Musa* spp. Unlike seed crops, vegetatively propagated plants, such as banana, pose a challenge for conservation. Moreover, banana being a monocot, it is far more difficult to dissect and excise its meristems for cryopreservation.

Traditionally, conservation of the crop was practised in field genebanks, and more recently as slow-growing *in vitro* cultures in Tissue Culture Repositories. Currently, cryopreservation of explants, derived from *in vitro* cultures, at ultra-low temperature (–196°C) in liquid nitrogen (LN), is viewed as the most viable, efficient and economical method for long-term and safe conservation for the vegetatively propagated crop. Workable protocol for *Musa* cryopreservation, using *in vitro* derived shoot meristems, was developed at the Katholieke Universitiet of Leuven, Belgium (since 2002), and has been adapted at the NBPGR, New Delhi. However, before applying protocol for cryobanking germplasm, it was imperative to study field performance of plants derived from the cryopreserved apices.

Banana plant derived from cryopreserved meristem

Experiments were carried with banana cv Sommrani Monthan (AAB, Monthan subgroup, IC250538), which had been collected from Hajipur in Bihar during 1994; planted in the field genebank. *In vitro* shoot-tip cultures of this were established and conserved. In late 2004, experiments were initiated for cryopreservation, using proliferating meristems method. This was done by repeated subculture of shoots on medium containing high (50-100 µM) benzylaminopurine (BAP). After 10-12 subculture cycles, 'cauliflower'-like meristems were obtained, which were used for cryopreservation. Meristems were precultured on a medium to induce dehydration tolerance in the tissues. Prior to cryopreservation, explants were excised and subjected to cryoprotectant treatment with glycerol, ethylene glycol and dimethyl sulfoxide (called as plant vitrification solution or PVS2). Cryopreserved meristems were stored in liquid nitrogen for a month and subsequently thawed and processed for regeneration into whole plants. Mean shoot regeneration in control (PVS2 treated but without LN exposure) was 56.5%. In the LN treated explants, 41% shoot regeneration was obtained in cultures treated with PVS2 for 120 min. About 40% meristems recovered successfully into plantlets. These plantlets along with PVS2 treated control plantlets and *in vitro* conserved plantlets were hardened for field transfer. In 2007, the plants were transferred in the field at the NBPGR, and they had come to bearing in July 2008. Results indicated no significant differences for major growth and yield parameters analyzed in all plants. Control and cryopreserved plants have fruited equally well in Delhi, where conditions for cultivating banana are not ideal. Cryopreservation of banana will ensure its safe conservation for perpetuity.

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National Research Centre on Plant Biotechnology

The National Research Centre on Plant Biotechnology (NRCPB) was established in 1985 with a vision to impart biotechnology advantage for the much-needed thrust to Indian Agriculture. The Centre had adopted relatively softer option of tissue-culture based research in its infancy in view of the build-up time required for a strong self-sustaining infrastructure.

Today, it stands poised to deliver impact-making results of research being pursued in upfront areas of plant biotechnology. Cloning of genes and promoters of agronomic importance, development of transgenic crops with improved resistance to biotic and abiotic stresses, structural and functional genomics, utilization of existing genetic variability by developing molecular-aided selection, exploitation of heterosis, quality improvement by genetic engineering and biological nitrogen fixation are some of the salient research objectives being actively pursued at the Centre.

MANDATE

- To undertake plant molecular biology research for understanding molecular mechanisms underlying basic biological processes.
- To device tools and techniques of biotechnology for crop improvement.
- To apply knowledge of genomics for advancing agricultural production.
- To serve as the national lead centre for plant molecular biology and biotechnology research and to create trained manpower in plant biotechnology.

INFRASTRUCTURAL DEVELOPMENT

Keeping pace with the international developments, the centre has moved into the era of genomics and bioinformatics by participating in an international endeavour to sequence rice genome. Consequently, genomics facility was developed, which consists of four laboratories—Physical Mapping Laboratory, Shotgun Cloning Laboratory, Sequencing Laboratory and Genoformatics data centre. The laboratories are equipped with state-of-the-art facilities.

A glasshouse has been constructed with proper facilities for testing transgenic plants.

SIGNIFICANT RESEARCH HIGHLIGHTS

High-yielding mustard

A somaclone of mustard as Pusa Jaikisan was released in 1994 for commercial cultivation. This has become immensely popular among farmers even in the zones for which it was not recommended. Later another variety Pusa Gold (yellow sarson) was also released.

Mustard hybrids

Somatic hybrids were produced involving mustard and several of its wild allies. Several cytoplasmic male sterility systems of mustard have been developed by combining cytoplasms of wild relatives, *Brassica oxyrhina, Diplotaxis catholica, Trachystoma ballii* and *Moricandia arvensis,* with the nucleus of the mustard through repeated backcrossing of respective somatic hybrids with mustard. *M. arvensis* based CMS and restorer lines have been distributed to breeders for developing commercial hybrids. Mustard hybrid NRC Sankar Sarson based on *Moricandia* CMS has been released for cultivation

Bacterial blight resistant Basmati rice

A serious constraint to Basmati rice production in the country is the high level of susceptibility of all the Basmati varieties to bacterial blight (BB), caused by *Xanthomonas oryzae*. Molecular markers linked to genes *xa13* and *Xa21* for BB resistance were used to transfer genes from a non-Basmati rice line IRBB 55 to Pusa Basmati 1 (PBI). A new variety named as imporved Pusa Basmati 1 was released for commercial cultivation in 2007.

Blast resistant rice lines

Two closely linked SSR markers, TRS 26/RM 206 and TRS 33, tightly linked to rice-blast resistance genes, were mapped at 0.7 cm and 0.5 cm flanking to Pi-k^h gene on the long arm of rice chromosome 11. The closely linked SSRs are being used for marker-assisted selection in pyramiding Pi-k^h gene along with other blast resistant genes. Map-based cloning of Pi-k^h gene from rice line Tetep has been accomplished. This gene has been functionally validated in a blast susceptible Japonica rice line using transgenic approach.

Bollworm resistant transgenic cotton

A *Bt* gene coding for Cry1Ac toxin was introduced in a cotton variety Bikaneri Narma and is field-tested. Transgenic cotton exhibited very high levels of bollworm protection.

Insect resistant transgenic brinjal

A gene encoding Cry1F delta-endotoxin of *Bt* was constructed and introduced in brinjal Pusa Purple Long.

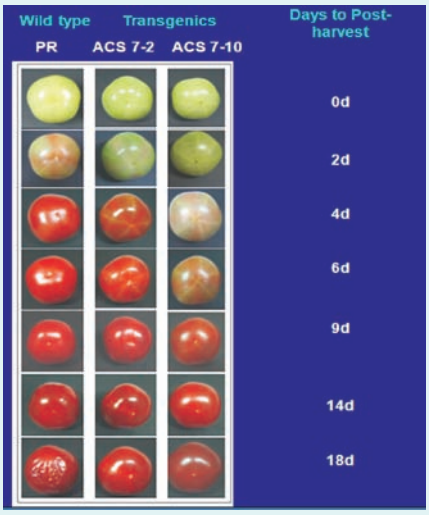
Fruit damage in transgenic lines varied from 4 to 7% in contrast to 35-43% in normal fruits. **NRCPB has signed a Memorandum of Understanding (MOU) with four private seed companies for field-testing, bio-safety testing and commercialization of *Bt*-brinjal.**

Salinity tolerant transgenic tomato

Transgenic tomato tolerant to salinity has been developed with *osmotin* gene under the control of constitutive CaMV 35S promoter. The transgenics are currently undergoing contained field trials.

Transgenic tomato with extended shelf-life and improved quality

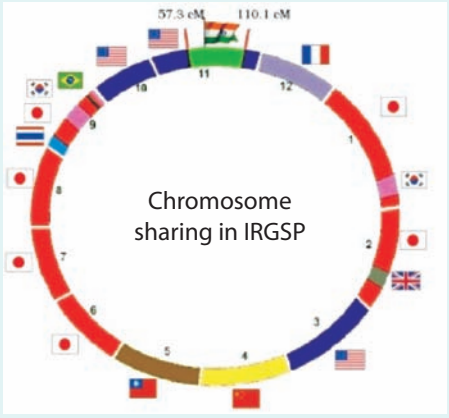
Transgenic tomato with delayed ripening and extended shelf-life has been developed by expressing anti-sense *ACC synthase* gene under the control of fruit-specific promoter LeACS4. The transgenics are being tested.



Fruits stored at room temperature (32^{0}C)

Sequencing of base pairs 8.2 million of rice genome

This Centre is one of the two centres involved in the Indian Initiative for the Rice Genome Sequencing (IRGS); the other is Delhi University, South Campus. The Centre sequenced long arm of chromosome 11 between map positions 57.3 cM to 84.3 cM, and generated a total of 8.2 million bases of high quality sequence, which is now available in the public domain. This sequence is being used for the identification of many agriculturally important genes and DNA markers using bioinformatics tools.



Codon-modified synthetic genes encoding delta endotoxins of *Bt*

Transgenic crops for insect resistance are developed by introducing genes encoding delta endotoxins of *Bacillus*

Protection against tobacco caterpillar conferred by Cry 1Fa1

thuringiensis (*Bt*). *Bt* genes are redesigned to make them resemble plant genes and to express in plant cells efficiently. Three codon-modified genes coding for *Bt* toxins Cry1X, Cry1Fa1 and Cry2Aa1 were constructed and validated in transgenic model systems for their efficacy to confer protection against major pests such as cotton bollworm, tobacco caterpillar, stem borers and fruit borers.

Novel constitutive promoter

Identification and analysis of DNA sequences controlling gene regulation is critical for devising intelligent strategies for genetic engineering. Over the years numerous promoters have been isolated from a wide variety of organisms for use in gene expression. New promoter elements have been cloned from *Arabidopsis thaliana* which show high and constitutive expression of cognate genes.

Another specific promoter using T-DNA tagging

Promoters with spatial and temporal expression patterns were identified to manipulate responses to biotic and abiotic stresses. Screening of a mutagenized population of *Arabidopsis* (Carrying T-DNA with a promoter-less *GUS* gene) led to the identification of anther specific promoters. A transgenic line of *Arabidopsis* exhibiting anther specific GUS expression was identified. Analysis of the upstream sequences has led to the identification of a 667 bp fragment (-667 to -1) of the peroxidase promoter that regulates *GUS* expression specifically in the developing anthers.

Lectin genes from chickpea

Lectins are highly specific carbohydrate-binding proteins which are useful against sap-sucking insects, aphids and whiteflies. A lectin gene was cloned from chickpea, characterized and transferred to *Brassica juncea* L. cv Pusa Jaikisan by using *Agrobacterium*-mediated transformation.

DNA fingerprinting for variety identification

This technology has been developed for rice, wheat, mustard, sugarcane, jute and tobacco. The commercially important Basmati varieties have been fingerprinted using gene-based markers. Molecular bar codes using these DNA fingerprints have been designed for use in Basmati trade and commerce.

Development of databases

The GM Crops database stores information related to transgenic crops being grown in India from reliable sources. At present the database has information on 135 transgenic cotton lines developed by various private companies for cultivation in India.

A central data warehouse consisting of genome sequence data has been constructed on rice, maize, brassica, chickpea, banana and tomato. The genome sequence database stores information on different categories of sequences like complete genome sequences, cDNA (complementary DNA) sequences, EST (Expressed Sequence Tags) sequences, Unigene sequences, end sequences (BAC/PAC/YAC), STS (Sequences Tagged Site) sequences, HTG (High Throughput Genomic) sequence, GSS (Genome Survey Sequences) etc.

Another database was developed on cloned genes from rice, maize, brassica, chickpea, banana and tomato. In this database, all genes cloned and characterized till date have been stored for easy availability of information for online users. All the databases are accessible at www.nrcpb.org.

THRUST AREAS AND PRIORITIES

The programmes will be undertaken with focus on basic research, strategic research and anticipatory research, encompassing enhancement of crop productivity (heterosis and apomixis in mustard), reduction of chemical inputs in agriculture (rice and mustard genotypes resistant to pests and fungal diseases), discovery of novel genes and promoters (*Arabidopsis*, rice, mustard and linseed), development of transgenic crops resistant to biotic and abiotic stresses (rice, mustard and wheat), molecular breeding of rice, chickpea and mustard for disease resistance, unravelling plant genomes and their functions (rice, mustard, tomato, chickpea and pigeonpea), bioinformatics and biotechnological solutions to mitigate effects of global climate change (genes from extremophiles and C4 photosynthesis in rice and wheat).

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Varietal Releases

Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora

VL Madira 207 barnyard millet

VL Madira 207, a high-yielding, grain-smut resistant cultivar has been developed by pedigree method from VL Madira 172 (high-yielding variety) and GECH 506 (semi-dwarf genotype). The variety recorded 20.65% and 22.63% mean grain yield

superiority over VL Madira 29 and K1 across the states in rainfed areas, excluding Tamil Nadu and Gujarat. It has an improved plant type with high harvest index as compared to VL Madira 29 and K1.

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VL Soya 59 soybean

It is a high-yielding variety suitable for cultivation in rainfed, timely sown areas of Uttarakhand hills, Jammu and Kashmir and Himachal Pradesh. It has superior quality low linolenic acid (C18:3 as 3.96), which improves oxidative stability of the oil; hence improves its commercial value. The variety has showed significant yield superiority over best check VL Soya 47. It has 39.15% protein and 19.35% oil content, and showed moderate multiple resistance against pod blight (anthracnose) and target leaf spot, and moderate resistance to frog-eye leaf spot in the north-western hills.

VL Soya 63 soybean

It is suitable for rainfed, timely sown areas of hills of Uttarakhand, Jammu and Kashmir and Himachal Pradesh. It showed yield superiority over best check VL Soya 47. It has 41.04 % protein content and 17.91 % oil content. The variety is found possessing high multiple resistance against pod blight

(anthracnose) and target leaf spot, and moderate resistance to frog-eye leaf spot in the north-western hills.

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Rice brown planthopper incidence contained in Haryana, Punjab and western Uttar Pradesh

NCIPM, New Delhi. In *kharif* 2008, an unusual incidence of brown planthopper caused extensive damage to rice-crop, including popularly grown Basmati cultivars.

Conducive weather conditions in mid-September led the development and multiplication of brown plant-hopper (BPH). The incidence was noticed in the range of 20-40% in various fields of Basmati varieties Pusa Sugandh 4 (1121), Pusa Basmati 1 and CSR 30 in many villages of districts Sonepat and Panipat (Wajidpur, Sobouli, Holumbi Kalan, Narela, Atterna,

Nangal Kalan, Ujha). Timely application of Ethofenprox/ Buprofezin proved effective, and protected crop from further infestation. However delay in application resulted in high damage to the crop. Higher doses of nitrogenous fertilizer predisposes the crop and makes it more susceptible to BPH and diseases.

The pest remains near the base of the rice-plant above the water level, and goes unnoticed if the plants are not closely observed. Female insect lays eggs in masses by lacerating parenchymal tissues; the incubation period ranges from 4 to 8 days. The nymphs on emergence start feeding on young leaves. Later on, both nymphs and adults suck plant sap from basal portion of the plant. Under high infestation, leaves appear yellowish-brown and produce typical circular "hopper burn" symptoms, which later may result in lodging of the crop.

Epidemics of neck blast disease also caused havoc in the areas, which increased phenomenally after ear-head emergence and was as high as 40-50% in some fields. Timely spray of tricyclazole fungicide could manage the disease.

In Sobouli and Atterna villages, IPM programme was undertaken in about 40.47 hectares each in Basmati rice. In IPM fields, BPH and neck blast were managed effectively. Growing of *'dhaincha'* (*Sesbania* sp.), less use of nitrogenous

fertilizers, regular monitoring of crop and conservation of spider population by habitat management and timely application of insecticides (Ethofenprox) in infested fields helped in BPH management, and neck blast was suppressed by less use of urea, application of potash and timely application of tricyclazole fungicide.

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Hand-tool for easy separation of pomegranate arils

CIPHET, Ludhiana. This tool consists of fruit holders having knife arrangement, which penetrates into the peel. Due to the rotating action of the holders, fruit breaks into two irregular halves as the simultaneous effect of the tension with twist over peel surface. During this action, whole fruit shears; and inside arils become loosened, and can be separated easily. About 30-45% arils are separated in the process of irregular breaking. Tool accomodates medium sized (5-8 cm) fruits. And its material of fabrication is primarily wood and steel knives. With this tool drudgery is negligible and it is safe to use, is suitable for all varieties of pomegranate and no damage is done to arils as knives penetrate only into the peel. Its capacity is 5-7 kg/hr, and unit costs Rs 500.

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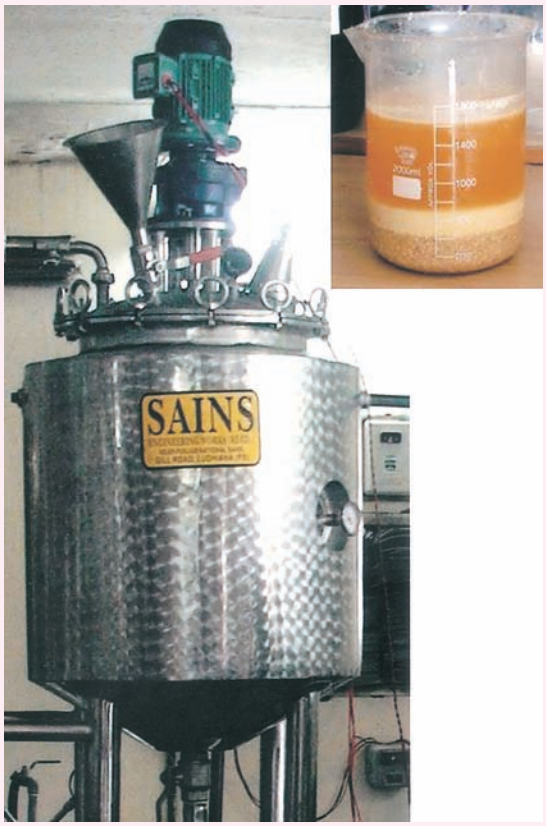
Bio-insecticide from mustard seeds

CIPHET, Ludhiana. Mustard seeds contain allylisothiocynate, which has insecticidal properties. The bitter taste and pungency of the mustard oil is due to the aromatic form of this chemical. This compound can be separated and used as a bio-insecticide. The yellow-coloured liquid contains waxy compounds along with aliphatic form of allylisothiocynate. This liquid bio-agent extracted from the seeds can be used effectively as an insecticide. M/s Indco Hightech Agro Rural D.W.W.S. has been licensed on non-exclusive basis to manufacture mustard-based bio-insecticide.

It is expected that the mustard-based bio-insecticide will go a long way in replacing inorganic chemical insecticides. Equipments required for production of this extract are mustard grinder, bioreactor and decantor. Other products



Mustrad extractor (*inset* yellow liquid)

obtained are mustard paste and mustard husk, which can be used for production of value-added products.

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CIPHET rotary maize-cob shellers

CIPHET, Ludhiana. Many hand-operated shellers developed are not commonly used because of high energy requirement and drudgery or low capacity. Rotary maize-cob shellers have been designed and developed with following features: simple and safe to use, drudgery neglible, suitable for all maize varieties, zero damage to grains, no cleaning of grains required, low and affordable cost for small and marginal farmers as well as agricultural labourers, most suitable for seed-producing agencies, seed shelling almost 100%.

For effective shelling of maize and for use by small and marginal farmers, following maize-cob shellers have been devised.

Rotary maize-cob sheller (Hand-operated). This sheller is attached to a stand in such a way that it provides circular motion to sheller with the help of a handle. Requirement of energy or to rotate the handle is taken into consideration at the time of its performance so that it is stipulated within the limits. One person is required to operate upon and insert cobs simultaneously.

Cost of the assembly with full fabrication charges is Rs 1,500.

However, low-cost rotary maize-cob sheller at a cost of Rs 700 has also been designed without brackets and bearings.

Rotary maize-cob with twin shellers (Hand-operated). Two rotary maize-cob shellers are attached to a stand in such a way that it provides circular motion to the shellers

simultaneously at the constant identical revolutions. Two persons are required for operation. The cost of the assembly with fabrication charges is Rs 1,800.

Rotary maize-cob with four identical shellers (Hand-cum-power-operated). Four identical rotary maize-cob shellers are attached to a stand that provides circular motion to four shellers at the constant revolutions at a time. Three persons are required to operate the sheller. One person is required to operate the handle, and care has to be taken that

Capacity (kg/hr) of different cob shellers

Shelling unit	Grade of cob		
	A (46-52 mm)	B (39-45 mm)	C (32-38 mm)
Hand-operated cob sheller with one shelling units	65.09	51.83	20.79
Hand-operated cob sheller with four shelling units	110.78	79.6	32.93
Hand-operated cob sheller with four shelling units	182.33	141.66	72.28
M/c operated cob sheller with four shelling units	249.48	167.5	92.33
CIAE cob sheller	26.64	20.41	12.10
CD%	16.2	19.15	10.64

500-mm pulley attached at the other end is not removed so that load at the other end is balanced for minimum energy requirement.

The cost of complete assembly with fabrication charges without motor is Rs 1,800. One fourth (¼) hp motor can be used for operating sheller that is easily available in the market between Rs 1,200 and Rs 1,500. However, two persons are required. If the sheller is operated by a ¼ hp motor.

Shelling capacity increased remarkably with rotary maize-cob shellers. Germination percentage of grains removed/shelled with developed shellers was found satisfactory. It was also observed that cobs not shelled by hand tubular maize sheller due to breakage of cobs could also be shelled with the rotary maize-cob shellers. The shellers can work in moisture content of grain/cob as high as 30-35%. However, best performance was recorded at 15-20% moisture content (wb). The highest shelling capacity of rotary maize-cob shellers was recorded for A grade (45-52mm width) cobs. Cobs having width up to 32 mm can be shelled successfully.

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Institutional innovations in agricultural supply chain of potato

NCAP, New Delhi. Increasing co-ordination in agricultural supply chains creates opportunities as well challenges for various stakeholders, R&D, farmers, traders, processors. Potato provides a classic example of an agricultural commodity, which has a wide range of specific uses and a lot of scope for value-addition. In India, potato supply chain is fragmented with little co-ordination and poor information flow, which results in high supply risks and transaction costs. To overcome weaknesses in potato supply chain, private sector has come up with some institutional innovations which seem to result in a win-win situation for all stakeholders.

Study of such institutional innovations has revealed that these have direct impact on the contract farmers. It was noted that potato yields realized by the contract growers were lower (13-30%) than of the non-contract growers. This was on account of the early harvest [necessitated for keeping tuber-size medium (chips-grade)], which is required to meet processing standards. However, the low yields were offset by realization of higher prices (22%) and lower transport and handling costs (74%) in comparison to selling in the open market. Overall, contact farmers received higher net returns (15-24%) than non-contract farmers.

In addition to direct tangible benefits, these innovations resulted in many spill-over effects for betterment of farming community. The most notable effect was higher investment by the contract farmers (52%) in farms assets as the result of higher realization from potato production. This is reinforced from the fact that about 45% farmers expanded area under potato cultivation.

Efforts are needed to focus on closer co-ordination between public and private sectors, especially for breeding programmes, infrastructural facilities, technology and credit support and perfect information flow among various stakeholders in the supply chain. Intellectual property rights (IPR) also will have bearing on encouraging more tightly aligned supply chains as the privatization of R&D and information markets would impact rate of innovation, distribution of benefits of innovations, and access to markets.

An efficient agricultural supply chain will provide not only higher returns to stakeholders, even food safety initiatives and regulations would also become easier to be enforced with lower implementation cost.

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Gold from wasteland – Tiger shrimp from inland saline water

CIFE, Mumbai. Tiger shrimp (*Penaeus monodon*), which grows in seawater is considered as the best marine shrimp (prawn) in terms of growth, meat quality and market demand globally, and it shares largest part of Indian fish export. This prawn is one such meat commodity which fetches very high price in comparison to chicken, mutton or most of the fishes available in the Indian market. The shrimps grown at Rohtak were sold at Rs 250 to 260 per kg in wholesale market at Delhi. In India, around 8 million hectares are affected with some form of salinity, which is rising with an alarming rate, more particularly in the north-western states.

Tiger shrimp does not survive in raw inland saline waters due to ionic differences with seawater. However, this shrimp could be commercially farmed in inland saline waters with cost-effective ionic management at Lahli-Baniyani Fish Farms, Rohtak, Haryana.

In a recent trial, the seed of tiger shrimp was stocked in two identical ponds of 0.25 ha with seed imported from Kakinada (Andhra Pradesh) at 44,000/ha (PL-10) for 4-month culture duration in 10 ppt salinity. The results indicated an overall survival of 65% with a net production of 700 kg/ha in 110-days culture duration.

A technology has also been developed for seed production of Giant freshwater prawn (scampi), using inland ground saline water at Rohtak, and commercial supply of seed to farmers of Haryana, Punjab and Uttar Pradesh has been initiated. Thus the area which had shown signs of threat can be seen as an opportunity for producing quality aqua-food.

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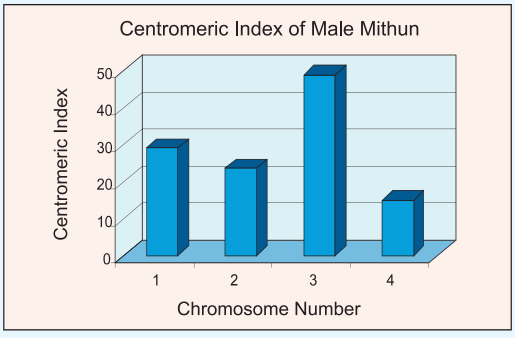
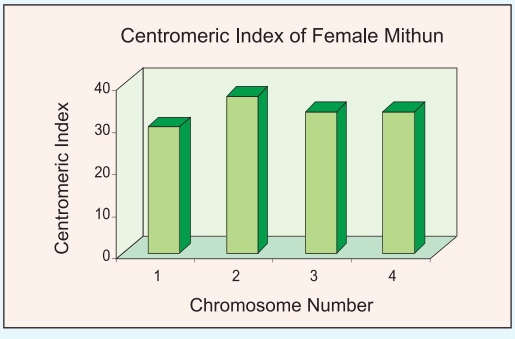
Mithun chromosomes cytogenetically analysed

NRC on Mithun, Nagaland. The relative size of the male and female chromosome in relation to other chromosomes of the set was ascertained by calculating relative length of the chromosomes. The morphology of the chromosome was established by estimating centromeric index of the mithun metaphase chromosome. The diagrammatic representation of the chromosomes was also done by preparing ideogram for male and female mithun metaphase chromosomes.





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Machine for spongy tissue detection in Alphonso mango

Dr Balasaheb Sawant Konkan Krishi Vidyapeath, Dapoli. The problem of spongy tissue in Alphonso mango is a major constraint in its export.

The University has developed a machine for detection of spongy tissue problem in Alphonso mango externally with the co-operation of the Central Electronic Engineering Research Institute, Chennai, and Indian Institute of Horticultural Research, Bangalore. The cost of the machine is 25 lakh. With the machine, spongy tissue-affected fruits can be separated easily by scanning.

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ICAR News **wishes its readers**
A Very Happy and Prosperous New year 2009

IMPACT OF TECHNOLOGY

Impact of agricultural research

Impact of Potato Research

NCAP, New Delhi. Potato accounted for nearly 43% of the total production of all roots and tubers at global level during triennium ending (TE) 2007. India ranked third in potato production (8%), after China (22%) and Russia Federation (12%) in TE 2007.

Potato production in India has increased significantly during the past two-and-a-half decades. About two-fold increase in area brought two-and-a-half-fold increase in production. The significant increase in both area and production of potato reflects contribution of potato research and development in the country.

So far, 42 potato varieties being grown in various parts of the country have been developed. Of these, 7 potato varieties, Kufri Jyoti, Kufri Chandramukhi, Kufri Sindhuri, Kufri Badashah, Kufri Bahar, Kufri Lalima, Kufri Lauvkar, are very popular. Chipsona 1, Chipsona 2 and Chipsona 3 are popular for processing purposes. Some of the potato varieties are being commercially cultivated in foreign countries—Kufri Jyoti in Sri Lanka and Nepal; Kufri Sindhuri and Kufri Lalima in Bangladesh; and Kufri Chandramukhi in Afghanistan.

Potato competes for area allocation mainly with wheat, gram, barley and sesamum. In 2007, potato shared 0.73% of gross cropped area (GCA) and wheat covered 14% area. In monetary terms, potato generated Rs 6,095 crore, and wheat Rs 43,167 crore (at 1999-2000 prices), accounting 1.4% and 10.2% of the total value of production (VOP) from crop sector, respectively. This reflects profitability of potato production over wheat.

Potato cultivation is confined mainly to Uttar Pradesh, West Bengal and Bihar; accounted for 72% of area and nearly 80% of production in TE 2007. Its cultivation in southern states is limited due to extensively hot climate. At all-India level, potato production during TE 2007 was about 23 million tonnes, which was from 1.4 million hectares with yield level of 17 tonnes/ha. At all-India level potato output growth (5%) was higher than wheat (3.5%) in 1990s. Recently (2001-06), output growth of potato and wheat has become negative (–0.2 % and –1.0%, respectively). The negative output growth is contributed mainly by yield. This calls for technology and policy support to correct the situation.

Analysis of the output supply response illustrates that potato price and research efforts have helped in promoting potato production . At all-India level, the long-run elasticities for potato price and research expenditures are 0.68 and 0.98, respectively. Hence, in the long -run, each 1% increase in research expenditure on potato would increase supply of potato production by 1%. Among potato-growing states, Uttar Pradesh contributes maximum (43%). Regression model shows that short-run price elasticity of supply for potato is 0.21, which is inelastic. The long-run price elasticity of supply for potato is estimated at 0.27. Thus, each 1% increase in price of potato causes supply of potato to increase to almost one-third. The short-run, cross-price elasticity of potato production with respect to wheat is –0.364. The long-run, cross-price elasticity –0.48. Estimation of long-run elasticity of research expenditure is 0.72. This shows that 1% increase in research expenditure in long-run would increase potato production by 0.72%.

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THE LAST PAGE

Realizing the importance of global and regional alliances to share information, knowledge and materials for research towards improving food, nutrition, environment security and agricultural sustainability, India has been making concerted efforts to develop close linkages with other countries and International Agricultural Research Institutions. Further, in the spirit of South-South co-operation, a number of programmes of co-operation with several developing countries in Asia and Africa have been developed.

India became a member of CGIAR in 1981, and at present, out of 15 CG institutes, regional/sub-regional offices of as many as 10 CG institutes are at New Delhi. And our country's financial contribution towards CGIAR research programmes is highest among the developing countries. Germplasm of rice, wheat, chickpea, pigeonpea, groundnut, sugarcane from India has benefited many countries for improving varieties.

Emergence of a new race of stem rust Ug99, followed by its quick spread in the African continent, raised an alarm among the wheat community worldwide. Reports are there that the pathogen, being wind-borne, has crossed Red sea. Estimates are that nearly 80% of all wheat varieties, planted in Asia and Africa, are susceptible to wheat stem rust and its variant. Realizing the potential and the magnitude of the threat, the ICAR in 2004 took initiative for forging international partnerships and co-operations to arrest menace. This led to the launching of the Borlaug Global Rust Initiative, to combat wheat rust; with India as one of the core members. A Ug99 Conference entitled "Wheat stem rust Ug99 – A threat to food security" was organized in New Delhi during November 2008, which dealt with all technical issues of Ug99 disease. And again in November, an extra-ordinary meeting of the SAARC Agriculture Ministers was organized in New Delhi, wherein SAARC Declaration on Ug 99 was made for addressing problem jointly. In addition, ICAR hosted a Global Agro-Industries Forum 2008; in which senior country delegates and professionals from 111 countries participated and shared experience in promoting agro-industries. A notable feature of the Conference was active participation of the Central Ministries of Agriculture, Commerce and Industries and Food Processing Industries, and Directors-General of FAO, UNIDO, and President, IFAD of United Nations.

The ICAR has entered into active co-operation with Uzbekistan, Brazil, Argentina, China, Namibia, Nepal, Sri Lanka, Egypt, Vietnam, Iran, Guyana, Bulgaria, France , Cuba , Eritrea and Australia for developing, promoting and accelerating closer collaborative effort for development of agricultural research and education. A large number of students from the countries in Asia and Africa are being enrolled every year for undergraduate, postgraduate and doctorate degree courses.

The Council arranges need-based training programmes for individual scientists or group of scientists in new and emerging areas. The ICAR has also initiated a major programme on agricultural knowledge empowerment of African countries.

Dr Mangala Rai, Secretary (DARE) and Director-General (ICAR)

The four-year action plan addresses needs of HRD and technological interventions for water management; seed, saplings and planting materials; crop and livestock husbandry; farm mechanization, post-harvest processing; and exchange of literature and planting materials. Investment of over Rs 150 crore, approved by Govt of India, to implement action plan would result in the knowledge empowerment of 1,800 persons from African countries and establishment of 300 field-demonstration units on different aspects of agriculture.

The complexities of the challenges agriculture faces have also evolved over time from being localized or country-specific to often transcending geo-political boundaries. The IARI has been identified as the lead institute for the Agricultural Impact Assessment Study under the UNEP-RRC-AP programme on Atmospheric Brown Cloud. The issues of climate change, genetic resources, water, movement of pathogens of plants and animals, sharing research materials, resources, technologies and knowledge, food security, trade, IPRs and human resource development would call for collective action on the part of governments, international agricultural research institutions/ organizations and all stakeholders. Co-operation among institutions to deal with transboundary problems in agriculture is imperative in view of the fact that technological interventions are becoming both capital-and-knowledge intensive, wherein a single NARS/institution may face logistic problems in attaining and sustaining enhanced growth. The system of agricultural research and education, consisting mainly of the ICAR and the SAUs, is considered as the role model for many developing countries. Based on the strengths we have attained in agricultural research and education, India has emerged as an effective partner/collaborator in agricultural R&D and as a provider of agricultural technology. We must strive to attain excellence, as it is through excellence alone we can sustain our position in agricultural research and education at the global level.

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