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MoU between Indian Council of Agricultural Research and Royal Botanic Gardens for Collaborative Research and Education in Plant Genetic Resources Conservation

A Memorandum of Understanding (MoU) was signed between the Indian Council of Agricultural Research (ICAR), New Delhi and the Royal Botanic Gardens (RBG), Kew, United Kingdom, on February 13, 2014. The MoU was signed by Dr S. Ayyappan, Secretary, Department of Agricultural Research and Education (DARE) and Director General (DG), ICAR and Mr Richard Deverell, Director, RBG. The objective of the MoU is to promote research on climate change and stress biology, high value agriculture and nutrition, and plant conservation science. Conservation of plant genetic resources (PGR) at NBPGR, especially for difficult-to-store species and poor storers would be the focus (especially tree species). International trainings for human resource development on plant conservation biology are envisaged, especially for participants from developing countries of Asia and Africa. Some significant areas of collaborative research envisaged in the MoU include (i) cryopreservation of fruit trees and other potentially 'intractable' species using buds, pollen, seeds, embryos or cells; (ii) frequency of seed desiccation in the Indian flora based on ecological correlates such as seed coat ratio and seed mass; (iii) gene mining for dormancy and other functional traits, including stress tolerance, in the Indian flora (cultivated species); (iv) clinical assessment of seed persistence in the Indian flora – seed mass and light requirements for germination, including of species of agricultural landscapes, (v) seed conservation science and banking of cultivated species from Indian biodiversity hotspots – North-East India (Indo-Burma flora), Himalayas and Western Ghats; (vi) cold stress at high altitudes – mechanisms by which seeds of (cultivated) Himalayan plants tolerate winter; (viii) chemical characterization of Indian oilseeds – fat composition and stability in the context of seed storage; (ix) volatile fingerprints of conserved seeds for the early diagnosis of loss of viability. The MoU shall be valid up to December 31, 2019.

Signing of MoU between ICAR and RBG at New Delhi on February 13, 2014. From left to right, Dr S. Ayyappan, Secretary, DARE and DG, ICAR; Mr Richard Deverell, Director, RBG, Kew; Dr K.C. Bansal, Director, NBPGR; Professor Hugh Pritchard, RBG, Kew; Mr. Arvind Kaushal, Secretary, ICAR and Additional Secretary, DARE

Exploration and Germplasm Collection

Exploration in Western Ghats for CWR

Abelmoschus angulosus var. *grandiflorus* collected from Periyar Tiger Reserve, Kerala

An exploration for collecting crop wild relatives (CWR) was conducted in southern Palakkad region of the Western Ghats by NBPGR, Regional Station (RS), Thrissur, along with Indian Institute of Horticulture Research (IIHR), Bengaluru, during December 3-12, 2013. A total of 83 collections comprising *Abelmoschus angulosus* var. *grandiflorus* (15), *A. caillei* (6), *A. esculentus* (1), *A. moschatus* ssp. *moschatus* (4), *A. moschatus* ssp. *tuberosus* (1), *Cucumis sativus* var. *hardwickii* (10), *C. maderaspatana* (1), *C. leiospermus* (1), *C. silentvalleyi* (2), *Capsicum chinense* (2.), *C. frutescens* (1), *Solanum incanum* (5), *Momordica charantia* var. *muricata* (3) *Cajanus scarabaeoides* (1), *Macrotyloma ciliatum* (1), *Sesamum malabaricum* (1), *Vigna dalzelliana* (16), *V. radiata* var. *sublobata* (2) and *V. trinervia* var. *trinervia* (9) were made. Wild stands of *Macrotyloma uniflorum* (in early flowering), *M. ciliatum* and *Trichosanthes nervifolia* were observed.

Collecting of Minor Leafy Vegetables

An exploration mission for collecting of minor leafy vegetables was undertaken by NBPGR, RS, Cuttack, in collaboration with Indian Institute of Vegetable Research (IIVR), Varanasi, during January 13-24, 2014. Areas covered were Nayagarh, Boudh, Bolangir and Bargarh districts of Odisha. A total of 154 germplasm samples comprising leafy amaranths (95), *Hibiscus sabdariffa* (4), *Basella alba* (5), *Coriandrum sativum* (2), *Ipomoea aquatica* (1), *Lathyrus sativus* (4), leafy *Corchorus* sp. (9), *Trigonella* sp. (4), *Spinacia oleracea* (3), *Brassica napus* (1), less known weedy/wild minor leafy vegetables (21) were collected.

Collecting of Wild *Oryza* Species

Parts of Telanagana region of Andhra Pradesh including Medak (Pocharam and Manjeera Sanctuaries), Ranga Reddy, Nizamabad and Khammam were surveyed for *Oryza* wild species by NBPGR, RS, Hyderabad, in collaboration with Directorate of Rice Research (DRR), Hyderabad. Live plants and/or seeds of 54 wild *Oryza* species were collected.

Germplasm Exchange

Import and Export

A total of 7,518 accessions (6,691 germplasm and 827 trial material) of different crops were introduced from 24 countries. Twelve accessions of four crops were exported to two countries.

Promising introductions

- **Bottle gourd** (EC800995-800998), **USA**: Resistant lines to powdery mildew, fusarium wilt, anthracnose, zucchini yellow mosaic virus (ZYMV).
- **Colocynth** (EC801008-801015), **USA**: Resistant lines to watermelon bud necrosis virus.
- **Cotton** (EC801556-801658), **USA**: American upland cotton germplasm lines.
- **Maize** (EC798378), **USA**: High level of resistance to maize dwarf mosaic virus, sugarcane mosaic virus and maize chlorotic dwarf virus.
- **Maize** (EC799592), **USA:** Transgenic maize parental inbred line with event TC1507 x NK603.
- **Muskmelon** (EC802405-802415), **USA**: Resistant lines to powdery mildew, fusarium wilt, anthracnose, ZYMV.
- **Pearl millet** (EC802313), USA: Genetic male sterile (ms3) stock NM-10H.
- **Pomegranate** (EC798720-798851), **USA**: Diverse germplasm and improved varieties in pomegranate.

- **Rice** (EC798169-798217), **Korea:** Rice transgenic T-DNA insertion mutant lines.
- **Rice** (EC801414-801441), **USA**: Drought tolerance and good cooking quality.
- **Rice** (EC801442-801555), **China**: Disease tolerance, shattering tolerance, lodging tolerance, grain quality, drought tolerance, cooking quality, insect tolerance.
- **Rice** (EC801659-801729), **Philippines**: New sources of resistance to biotic stresses derived from wild species introgression lines.
- **Seabuckthorn** (EC802416-802417), **Latvia**: Large fruits (100-fruit weight 60-110 g), high vitamin C content (81 mg/100g).
- **Tomato** (EC797177),**Taiwan**: Resistant to bacterial wilt, orange coloured fruit, green stem.
- **Watermelon** (EC800999-801022), **USA**: Resistant lines to watermelon bud necrosis virus.
- **Wheat** (EC799617-799754), **Mexico**: Genetic stocks for analysis of pathotypes in rusts and powdery mildew pathogen of wheat stem rust, brown/leaf rust, and yellow rust genes from different wild species and improved varieties.

Plant Quarantine

A total of 3,701 imported samples comprising germplasm, trials and transgenics were processed for quarantine clearance atNBPGR New Delhi, and **3,470** samples at NBPGR, RS, Hyderabad. Of these 57 samples were found infected/infested. Four samples were rejected and 53 samples were salvaged using physico-chemical treatments.

Germplasm Characterization and Evaluation

A New Viral Disease Identified during Screening of Brinjal Germplasm

Screening of 518 accessions of brinjal germplasm grown at Issapur farm, NBPGR during 2013, revealed occurrence of a new virus disease resembling mottling, in 89 accessions. Electron microscopy of symptomatic leaf sample revealed ~650 nm flexuous particle of viruses and the particle is close to potyvirus. Percent disease incidence (PDI) was 10-80. The same infection was also observed in check *Pusa Sadabahar* (PDI = 12.5).

Brinjal plant with viral symptoms on leaf; inset shows EM of the causal virus

Rice Bean Germplasm from NEH

Rice bean (*Vigna umbellata),* an important under-utilized rainfed legume of North-eastern hill (NEH) region of India. Over the past five years, NBPGR R/S has augmented more than 600 accessions which have been characterized and many promising accessions identified for different characters, as shown below:

Trait	Range of variability	Promising accessions
Days to 50% flowering	36-78	
No. of branches/plant	1.6-19.8	IC524522, IC538870, IC524082, IC419518
Plant height (cm)	12.4-162.0	
Pod length (cm)	2.1-13.8	IC538878, IC137189, MRS-82
100 Seed weight (g)	3.7-35.3	IC524074
No. of pods/plant	18.6-332	IC419518, IC524522, IC524074, MRS-93
Days to 80% maturity	91-156	IC524522, IC524068
Seed yield/plant (g)	20.6-435.5	IC524074, IC524522, IC395028, MRS-82

Germplasm Characterization and Evaluation at NBPGR, RS, Thrissur

In horsegram (*Macrotyloma uniflorum*) data were recorded for plant height, number of primary branches, number of pods per plant, pod length, pod width and number of seeds per pod in 115 accessions. The single plant yield of accessions IC277702 (163 pods), IC145326 (143), IC139461 (136), IC089027 (147), IC071792 (143), IC016170 (250), IC145293 (170), IC019498 (133), IC068602 (125), IC023477A (170), IC023445 (140), IC089030 (178) and IC89028 (257) were high compared to others.

Accession IC023477A of horsegram identified for high number of pods/plant (175 pods)

In rice, 105 accessions were characterized for 10 qualitative and 11 quantitative characters. Forty-six accessions were found to be superior for grain yield/hill with more than 23.0 g compared to the best check Thulasi (11.5 g). Superior accessions identified were IC085759 (26.4), IC350703 (44.9), IC350715 (44.3), IC350716 (24.3), IC350741 (24.5), IC350742 (26.6), IC350743 (26.7), IC537470 (23.8), IC537478 (35.2), IC537488 (26.9), IC537504 (25.8), IC324684 (23.1), IC324742 (42.6), IC324746 (32.9), IC203825 (31.7), IC248252 (26.1).

Twenty-six accessions of Chinese potato (*Plectranthus rotundifolius*) were characterised and evaluated for nine quantitative characters such as **single plant yield and tuber size**. Accession IC266674 was found superior for all the characters and IC468965 for single plant yield (432.5 g).

Identification of Unique Germplasm of Indian Mustard

A total of 85 accessions of leafy vegetable type of Indian mustard (*Brassica juncea*) collected from NEH region during February 2012 were characterized during *rabi* 2012-13. Accession IC597917 was found to have unique lacerate type of leaf character and the same was validated during *rabi* 2013-14. This unique character can be utilized for biotic or abiotic stress tolerance breeding.

Indian mustard germplasm showing lacerate type of leaf

New Species of *Vigna* Circumscribed

A new species of the genus *Vigna* Savi of the Section *Ceratotropis viz.*, ***Vigna konkanensis*** **Latha, K.V. Bhat, I.S. Bisht, Scariah, Joseph John et Krishnaraj** was described and illustrated from the West Coast of India. This species is closely allied to *V. sublobata* (Roxb.) Babu and S.K. Sharma and *V. hainiana* Babu et al. However, it differs from both in having glabrous stem, stipule, leaflets, and inflorescence, acute leaflets, immature pods without a pinkish spot at the apex, mature pods with sparsely short setose hairs and seeds rough with appressed concentric reticulations on testa.

Vigna konkanensis, a new species described from Konkan region

Genomic Resources Generation

Bottle gourd (*Lagenaria siceraria*), a non-model crop, was studied for simple sequence repeat (SSR) marker survey and characterization using the next generation sequencing (NGS) technique. A genome wide analysis was conducted using recently available restriction site-associated DNA sequencing (RAD-Seq) - a NGS based scaffolds/contigs sequences data and identified 44,823 perfect microsatellite repeat-motifs spanning ~334 Mb of bottle gourd genome. Some of these markers have been mapped on to linkage groups for bottle gourd and their synteny with cucumber, muskmelon and watermelon has been compared. Of the 44,823 microsatellites, a subset of 103 (~0.2%) markers was successfully validated in five accessions of bottle gourd.

In sponge gourd (*Luffa cylindrica*) 60 sequence related amplified polymorphic (SRAP) markers were screened to identify, out of which 20 identified markers were used to profile 45 lines of sponge gourd. In barnyard millet (*Echinochloa frumentacea*), 20 new SSR markers were generated through cross-species transferability approach by using the markers from finger millet and pearl millet.

In chilli (*Capsicum frutescens*) 96 novel sequence-tagged microsatellite sites (STMS) markers were developed through enrichment of small insert genomic library constructed in the variety 'Pusa Jwala'. The utility of these markers has been tested by amplification of markers generated in 28 varieties of chilli. These markers add to the technology developed for DNA fingerprinting in chilli.

Germplasm Field Days

Sunflower Field Day

A sunflower field day was jointly organized by NBPGR, New Delhi, Directorate of Oilseed Research (DOR), Hyderabad and Oilseed Research Station (ORS), Latur, Maharashtra, on February 5-6, 2014 at Latur. Dr B. Venkateswarlu, Vice-Chancellor, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, inaugurated the function and Dr Y.S. Nerkar, Former Vice-Chancellor, Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri, was the Chief Guest. Dr R.K. Tyagi, Head, Division of Germplasm Conservation, NBPGR, was also present. A total of 50 sunflower breeders from 10 organizations participated in the field day and selected the germplasm. A total of 1,093 accessions from NBPGR, 490 from ORS, Latur, 369 from DOR, Hyderabad, 45 from PAU, Ludhiana, were grown in the field for selection by the breeders.

Dr Y.S. Nerkar (second from left), former Vice Chancellor, MPKV, Rahuri, at the sunflower field day at Latur

Rapeseed- Mustard Field Day

Germplasm field day on rapeseed-mustard was organized at NBPGR Experimental Farm, Issapur, New Delhi on February 25, 2014. A total of 1,282 accessions including 346 accessions of vegetable type *Brassica* sp., 332 accessions of *B. napus* were grown for characterization and multiplication. Besides these, 604 accessions of unidentified species of rapeseed-mustard germplasm from NBPGR genebank were grown for taxonomic identification. More than 25 participants from ICAR institutes and SAUs attended this important event.

Wheat Field Day

Wheat field day was organized at NBPGR Issapur Farm, New Delhi on March 20, 2014. During the *rabi* season 2013-14, about 4,316 wheat accessions are grown for validation of core set and terminal heat tolerance study. The field day was attended by 45 participants from different ICAR institutes and SAUs. The participants selected material of their choice for specific traits and placed the indents for supply.

TRAININGS, MEETINGS AND FAIRS ORGANIZED

International Training Course on '*In Vitro* Conservation and Cryopreservation'

The seventh international training course under the Centre of Excellence programme of ICAR-Bioversity International on '*In Vitro* and Cryopreservation Techniques for Conservation of Plant Genetic Resources' was organized from 17-28, 2014 by NBPGR, Bioversity International, South Asia Office, APCoAB, New Delhi. The 12 international participants were from Malaysia, Sri Lanka, Uganda, Thailand, Cuba, Benin, Nigeria, Zambia, Burkina Faso, Tanzania and Fiji. Indian trainees were from IFGTB, ICFRE, KAU, TBGRI and IARI. External faculty included Dr J.L. Karihaloo, APCoAB, Dr S.R. Bhat, NRCPB, IARI, Prof Hugh Pritchard, Royal Botanic Gardens, Kew, UK, and Dr Bart Panis, Leuven, Belgium. A total of 23 lectures and11 practicals related to different topics of *in vitro* conservation and cryopreservation of germplasm for vegetatively propagated and non-orthodox seed species along with of molecular tools for PGR management and conservation of plant genomic resources were delivered.

Training on 'Conservation of Orthodox Seed Species in Genebank'

Participants of the Training on 'Conservation of Orthodox Seed Species in Genebank'

A training on 'Conservation of Orthodox Seeds in Genebank' was jointly organized by NBPGR and Protection of Plant Varieties and Farmer's Rights Authority (PPV&FRA) from March 21-22, 2014, at the Division of Germplasm Conservation, NBPGR. The training was inaugurated by Dr. K.C. Bansal, Director, NBPGR in the presence of Dr. R.C. Agrawal, Registrar-General, PPV&FRA. A total of 19 participants representing various ICAR institutes, SAUs and private sector organizations were trained in various aspects of seed conservation, PPVFRA Act, and DUS testing by 23 faculty members belonging to NBPGR, IARI and PPV&FRA. Dr. J.S. Chauhan, ADG (Seeds) chaired the valedictory session.

Plant Germplasm Registration Committee Meeting

The XXVIIIth Plant Germplasm Registration Committee (PGRC) meeting was held at NBPGR, New Delhi on January 31, 2014 under the Chairmanship of Dr S.K. Dutta, DDG (CS), ICAR. A total 74 proposals (45 new and 29 revised) were considered for registration. Finally, 24 proposals belonging to 15 species were approved for registration. Some notable registered germplasm included castor pistilate line with unique morphotype of flower with hermaphrodite flower at tip and golden yellow leaf colour mutant of *isabagol.*

Public Outreach by NBPGR for PGR Awareness Generation

NBPGR participated in several farmers' fairs and a public outreach sessions to boost awareness on importance and use of PGR.

Women farmers visiting the NBPGR stall at Krishi Vasant 2014

The **'Krishi Vasant 2014'** India's largest Farmers' Fair was organized by Ministry of Agriculture, Govt. of India and Confederation of Indian Industries (CII) at Nagpur from February 9-13, 2014. The fair was inaugurated by the Hon'ble President of India, Shri Pranab Mukherjee in the presence of Minister of Agriculture, Shri Sharad

Pawar. NBPGR participated in the exhibition and showcased its achievements to the farming community. Besides farmers from various states (>5 lakhs), NBPGR's stall was visited by several government dignitaries, NGOs and students.

NBPGR pavilion at the 'Agri Fiesta 2014' held at KAU campus, Thrissur

NBPGR, R/S, Thrissur, participated in the **Agri Fiesta 2014** held at Kerala Agricultural University Campus, Thrissur from February 28 - March 6, 2014. A stall displaying live material, photographs and posters depicting the various activities and mandate of NBPGR was visited by nearly 50,000 visitors. There was a great demand for planting materials of the crops displayed in the stall, especially Burmese fishtail palm, 'thamarachakka', sweet type of *Aloe vera*, sweet gourd, teasel gourd, African horned cucumber, etc.

NBPGR also participated in the **Pusa Krishi Vigyan Mela,** organized by IARI at New Delhi from February 26-28, 2014, by exhibiting posters and live material at the thematic stall and other activities at the general stall using posters, live materials, pamphlets and brochures. The thematic stall was visited by Hon'ble Shri Sharad Pawar. The stalls were visited by a number of farmers, scientists, personnel from KVKs and school children.

NBPGR, R/S, Srinagar, participated in the **'ICAR Public Outreach Session'** during 101 Indian Science Congress held at University of Jammu from February 3-7, 2014. The session was organized by the Directorate of Knowledge Management in Agriculture (DKMA), ICAR, on February 5, in which local farmers interacted with the scientists of all local ICAR Institutes. Dr R.B. Singh, Former President, National Academy of Agricultural Sciences, chaired the session.

A **Biodiversity Fair** was organized by the NBPGR, R/S, Cuttack, in tribal areas at Tentala, Udala, Mayurbhanj in Odisha, on January 31, 2014, under the 'Tribal Sub Project'. About 300 tribal farmers participated and a research bulletin was released and circulated among the participants.

A **Plant Genetic Resources Awareness Programme cum Biodiversity Fair** was organized by NBPGR, R/S, Hyderabad in collaboration with Asha, an NGO, on December 11-12, 2013 at Alligudem and Boddugudem villages of Chinturu mandal in Khammam district of Andhra Pradesh. One hundred and fifty tribal farmers/members participated in the programme.

VISITORS AND LECTURES

Mr. Richard Deverell, Director, Royal Botanic Gardens, Kew, UK visits NBPGR

Mr. Richard Deverell, Director, **Royal Botanic Gardens, Kew, UK visited NBPGR, New Delhi, on** February 13, 2014 and delivered a talk on 'Royal Botanic Gardens, Kew' supported by Professor Hugh Pritchard from Kew. The dignitaries also visited the National Seed Genebank, Cryogenebank, *In Vitro* Genebank and Division of Genomic Resources.

Dr R.K.Tyagi, Mr Richard Deverell, Professor Hugh Pritchard and Dr Rekha Chaudhury (left to right) visiting the Seed Genebank of NBPGR

Dr S. Ayyappan, DG, ICAR, visits NBPGR on National Science Day

The National Science Day was celebrated at NBPGR on February 28, 2014 by holding a lecture of Dr S. Ayyappan, DG, ICAR, who spoke about the achievements and future plans of ICAR. He motivated all the staff and students to work together for creating a vibrant agricultural research and education ambience, which would directly impact farmers. The function was organized by the PGR Club of NBPGR.

Dr K.C. Bansal, Dr S. Ayyappan and Professor I.S. Bisht during the National Science Day celebration at NBPGR, New Delhi

PERSONNEL NEWS

Retirements

Mr Girish Chand Chandola, Assistant Administrative Officer & Drawing and Disbursing Officer, NBPGR, New Delhi, superannuated on February 28, 2014.

Mr M. Goswami, Technical Officer, NBPGR, RS, Umiam, Meghalaya superannuated on February 28, 2014.

Mr Hardev Prasad, Technical Assistant, NBPGR, New Delhi, superannuated on February 28, 2014.

Dr Manoranjan Dutta, Head, Division of Germplasm Evaluation, NBPGR, New Delhi, superannuated on March 31, 2014.

Mr M.S. Rathore, Senior Technical Officer. NBPGR, New Delhi, superannuated on March 31, 2014.

Promotions

Dr Nidhi Verma promoted to Principal Scientist w.e.f. July 5, 2012.

Dr Surendra Kumar Malik promoted to Principal Scientist w.e.f. November 27, 2012.

Dr Mukesh Kumar Rana promoted to Principal Scientist w.e.f. December 12, 2012.

The following scientists were promoted through the Departmental Promotion Committee **to the next higher grade (w.e.f) :**

Dr Chitra Pandey	June 11, 2012
Dr Sushil Pandey	June 16, 2012
Dr T.V. Prasad	June 17, 2012
Dr Z. Khan	June 25, 2012
Dr T.P. Singh	June 25, 2012
Dr Mohar Singh	June 26, 2012
Dr Rakesh Bhardwaj	December 31, 2012
Dr Ranbir Singh Rathi,	January 12, 2013
Dr Monendra Grover	January 18, 2013
Dr Tapan Kumar Mondal	February 17, 2013
Dr Sundeep Kumar	February 17, 2013
Dr Rajesh Kumar	April 20, 2013
Dr Sherry Jacob	June 12, 2011
Ms Madhubala Priyadarshi	November 13, 2011
Dr Amit K. Singh	June 26, 2012
Dr Parimalan R.	February 10, 2013

Recognition

Dr Manas Kumar Bag, Senior Scientist (Plant Pathology), Division of Germplasm Evaluation has been selected as Fellow, Association for the Advancement of Biodiversity Science, by the 'Association for the Advancement of Biodiversity Science (AABS)' during the International Conference on Biodiversity, Bioresources and Biotechnology, January 29-31, 2014, Mysore.

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