

ICAR-National Bureau of Plant Genetic Resources



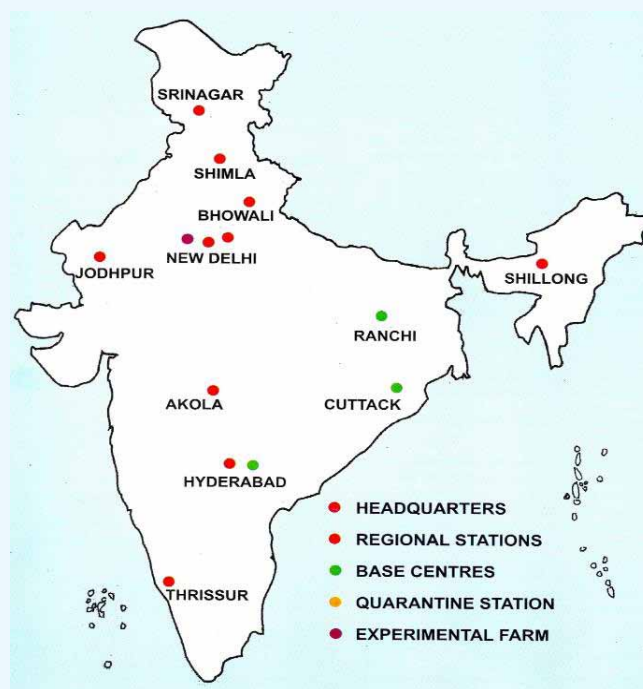
The National Bureau of Plant Genetic Resources is a premier institute under the Indian Council of Agricultural Research addressing all management issues related to plant genetic resources (PGR) — the basic raw material — for plant breeding and crop production.

Genesis

Dr B P Pal in his classic paper *A Search for New Genes* (1937), expressed the need of an organization for plant introduction and germplasm augmentation for crop improvement. In 1946, Plant Introduction — an ICAR scheme — was started in the then Botany Division of the Indian Agricultural Research Institute (IARI), New Delhi, 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 activities related to plant genetic resources (PGR) and in January 1977, this was rechristened as the National Bureau of Plant Genetic Resources.

ICAR-NBPGR has been given the mandate to act as a nodal institute at the national level for acquisition and management of indigenous and exotic PGR for agriculture, and to carry out related research and human resources development for sustainable

growth of agriculture. The Bureau is also vested with the authority to issue Import Permit and Phytosanitary Certificate and conduct quarantine checks in seed material and vegetative propagules (including transgenic material) introduced from abroad or exported for research purposes. Besides having a 40-ha



ICAR-NBPGR's national network to promote agricultural productivity through PGR

experimental farm at Issapur village, New Delhi (about 45 km West of Pusa Campus), the Bureau has a strong national network comprising 10 Regional Stations/ Base Centers located in different agro-ecological/ phyto-geographical regions which are engaged in management of PGR activities including collection, characterization, evaluation and maintenance of various crops. At the headquarters, Bureau has 5 Divisions, 3 units and 5 cells. Besides this, an All-India Coordinated Research Project on Potential Crops is also located at the Bureau. The 5 Divisions – Plant Exploration and Germplasm Collection, Plant Quarantine, Germplasm Evaluation, Germplasm Conservation, Genomic Resources and 3 Units – Germplasm Exchange and Policy, Tissue Culture and Cryopreservation, Agriculture Knowledge and Management Unit address various facets of germplasm collection, exchange, quarantine, characterization, evaluation, distribution, conservation, genomics, informatics and documentation.

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.

Objectives

- Plan, organize, conduct and coordinate exploration and collection of indigenous and exotic PGR
- Undertake introduction, exchange and quarantine of PGR
- Characterize, evaluate, document and conserve PGR and promote their use in collaboration with other national organizations
- Production/ multiplication and quality control of PGR for distribution
- Conduct and promote basic, strategic, applied and anticipatory research for development and management of PGR
- Human resource development including teaching and training, develop guidelines and create public awareness on PGR
- Collect and conserve DNA from plants, animals, fishes, micro-organisms and other relevant organisms which result from the various molecular genetics and genomics research programmes
- DNA fingerprinting for IPR protection and GM diagnostics
- Development of a user-friendly web-based

information system for PGR.

Infrastructure

Infrastructural facilities and research at the Bureau has 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 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 which is a fully functional Division now.

Salient Achievements

- Collection of over 2.77 lakh germplasm accessions (86% cultivated and 14% wild) of more than 2,000 species of various crops.
- Since 1976, more than 40 lakh samples of different crops were imported from over 100 countries; including 9,44,932 germplasm accessions and 31,85,832 samples of international trials/ nurseries from the CGIAR centres. Over 1.1 lakh samples were exported to research organizations after quarantine processing and domestic supply of more than 5.4 lakh samples were done.
- *Ex-situ* samples stored in seed genebank are more than 4.62 lakh, representing 2,049 species. Germplasm accessions totaling 1,896 of 145 species have been conserved using *in vitro* conservation methods, and 13,943 accessions have been cryopreserved in the form of embryos/ embryonic axes, seeds, dormant buds and pollen.
- About 2.51 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 30,000 accessions of different crops (including medicinal and aromatic plants) have been evaluated for quality traits. Similarly, more

than 50,000 accessions of different crops were evaluated for biotic stress and more than 35,000 accessions for abiotic stresses.

- Nearly 2100 varieties of over forty agri-horticultural crops have been DNA profiled and 9,093 accessions from 45 cultivated and endangered plant species have been conserved at -80°C and -196°C in the National Genomic Resources Repository (NGRR) <http://www.nbpgr.ernet.in:8080/NPGRR/Home.aspx>.
- PGR Portal, a web portal, was developed to access information on germplasm conserved in the National Greenbank. In addition, three mobile apps “Genebank”, “PGR Map” and “IP PGR” have been developed.

PGR policy unit — 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 Institute Technology Management Unit (ITMU) 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 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.

National Genebank — The Indian National Genebank

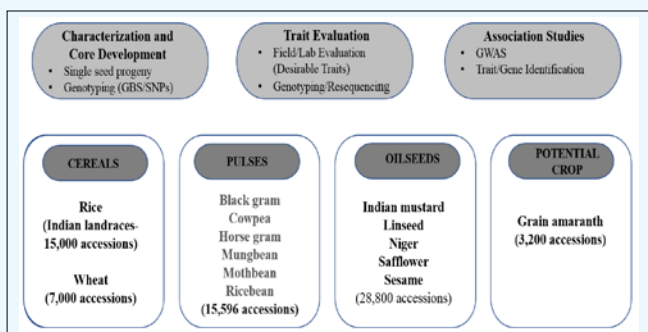
Core-collections developed at ICAR-NBPGR

Crop	No. of acc. characterized	No. of acc. in core collection	Descriptors	References
Wheat	22,464	2,226	34	Phogat <i>et al.</i> , 2020
Chickpea	14,651	1,103	21	Archak <i>et al.</i> , 2016
Barley	6,778	688	19	Kaur <i>et al.</i> , 2022
Sesame	2,489	343	19	Bisht <i>et al.</i> , 1998
Lentil	2,324	170	25	Tripathi <i>et al.</i> , 2022
Okra	1,960	265	22	Mahajan <i>et al.</i> , 1996
Brinjal	1,798	181	28	Gangopadhyay <i>et al.</i> , 2010
Wild lentil	405	96	18	Singh <i>et al.</i> , 2014

(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) maintained at -18°C; active/working collections (short- to medium-term storage) 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 0.75-1.0 million base collections. The present germplasm holding of around 0.462 million belonging to nearly 2,049 species is the largest genetic wealth conserved as *ex-situ* collection after Genebank of NPGS, USDA of the United States of America.

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, 48 meetings of the PGRC have been held, and a total of 1,984 trait-specific plant genetic stocks in 253 crop species have been registered and conserved at the NGB and NAGS.

PGR for trait discovery and achieving sustainable development goal — During last decade, large scale characterization and mega-evaluation of national genebank collections of various crops including wheat (~27,000), barley (~7,000), lentil (~2,000), chickpea (20,800), *Vigna* spp. (10,000), pea (~3000), mustard (5,000), sesame (~7,000), soybean (10,000), etc., have been accomplished to develop core sets, mini-core sets



Comprehensive phenotyping studies for trait discovery using genomic approaches in the crops conserved in National Genebank, New Delhi, India



Wheat germplasm characterization and evaluation



Sesame germplasm characterization and evaluation



Lentil germplasm characterization and evaluation

and trait-specific reference sets under NICRA project, DBT funded Network project and In-house projects. Various core sets have been developed (wheat: 2226 acc.; chickpea: 1103 acc.; barley: 688 acc.; lentil: 170 acc., ricebean: 252 acc.; mungbean: 400 acc.; cowpea:425 acc.) for utilization by respective crop researchers.

Under CRP on Agro-biodiversity-PGR Component-II, a total of 24,602 accessions comprising wheat (7,763 acc.), rice (5,900 acc.), okra (3,412 acc.), chickpea (2,136 acc.) and brassica (2,953 acc.) were evaluated at AICRP centres/ hotspots for quality traits, abiotic and biotic stresses. Promising accessions and GWAS panel were identified for genomics study and introgression breeding. Trait-specific germplasm for resistance to rust disease (4), spot blotch (4) and zinc content (2) in wheat, *Aschochyta* blight resistant (2) in chickpea and white rust resistant in Indian mustard (2) was identified.

National Herbarium of Cultivated Crops — The institute houses a unique National Herbarium of Cultivated Crops (NHCP). At present, it holds 25,590 herbarium specimens belonging to 267 families, 1,547 genera and 4,384 species, and 3,186 seed samples and 757 economic products. The herbarium acts as a source for authentication/ identification of new collections of

material and for many taxonomic and bio-systematic studies.

Human resource development — Over the years, training programmes have been conducted on scientific procedures for exploration and collection, exchange, quarantine, biosecurity, biosafety, DNA fingerprinting, evaluation, documentation and conservation of PGR for capacity building. About 300 training courses aimed at capacity-building of the NARS partners were organized. More than 1000 student-trainees from various educational institutions across the country worked in various laboratories of Bureau on biotechnological and other research areas during the past two decades. Since academic session 1997, Bureau is undertaking teaching in PGR leading to MSc degree linked with Post Graduate School, IARI, New Delhi. From the academic session 2004-2005, a PhD degree programme in PGR was also started. So far, a total of 73 MSc and 31 PhD degrees have been awarded in PGR discipline.

ICAR-NBPGR deposits seeds at Svalbard Global Seed Vault — The Svalbard Global Seed Vault (SGSV) is a safety duplicate vault on the island of Spitsbergen in Svalbard, Norway where it safeguards germplasm duplicates of more than 1,210,191 accessions, deposited by 93 institutes. The Seed Vault opened on 26 February 2008



and India donated five accessions to this vault in June, 2008 as goodwill gesture. ICAR-NBPGR had deposited earlier 25 accessions of pigeon pea in 2014 and 100 accessions each of rice and sorghum in year 2017. In October, 2022 India further added to its safety duplicate tally with the deposition of wheat (2,180 accessions) and chickpea (887 accessions), which represented the core sets in the respective crops. This contribution to the global conservation endeavour is a major milestone in NBPGR's PGR management mandate.

Wheat and chickpea core accessions deposited by ICAR-NBPGR at Svalbard Global Seed Vault as safety duplicate. These were deposited by Dr T R Sharma [DDG, Crop Science] and Dr D K Yadava [ADG, Seed] ICAR, India on 12 October 2022. Information on the deposits is available at the new version of seed portal launched in 2021 (<https://seedvault.nordgen.org>).

New initiatives by ICAR-NBPGR for PGR management

- Modernization of genebank
- Large scale characterization, evaluation and core set development including pre-breeding activities
- Generation of genomic resources for tolerance to abiotic and biotic stresses and nutritional quality
- Genomics assisted traits discovery using GWAS tools
- Development of G-DIRT (Germplasm Duplicate Identification and Removal Tool)
- Conservation and cryo-banking of selected vegetatively propagated species.
- Digitization of all herbarium specimens
- Launching of chip based technology for real-time and RFID passive monitoring of field genebank and agroforestry species

- Remote phenotyping of tree Germplasm by using Hyperspectral, Multi-spectral and RGB camera on a Drone under ICAR-NBPGR, IARI and ICRAF Collaboration
- Development of eco-friendly salvaging treatments for imported germplasm

GM Detection Research Facility (GDRF) — Accredited as per international standards ISO:IEC 17025:2017 by the National Accreditation Board for Testing and Calibration Laboratories (NABL), a Constituent Board of Quality Council of India. It was designated as the National Referral Laboratory to detect the presence or absence of LMOs and GMOs under sub-section (1) of Section 4 of the Seeds Act, 1966 in the Gazette of India Notification (DAC&FW, MoA&FW, Govt. of India) dated 15 November 2017. GDRF is coordinating the Network of GMO Testing Laboratories (NGTL) of India <http://gmolabs.nbpgr.ernet.in:9090>

PGR informatics — PGR Informatics enhances the efficiency of PGR management by researchers, policy makers, and funding agencies. An organized digital information system provides fair and just opportunity for all to access. Therefore, the need for countries to develop, maintain and exchange information “from all publicly available sources, relevant to conservation and sustainable use of biological diversity” including “results of technical, scientific and socioeconomic research” is recognized in the Convention on Biological Diversity (CBD, Articles 7d, 17), and the Global Plan of Action (GPA, priority activities 17 and 18). Information of this nature is imperative for planning and implementing activities; sustainable use and sharing of benefits accrued from its use. PGR Informatics manages (creation, storage, retrieval and presentation) and analyses (discovery,

NBPGR Mobile Applications

NBPGR Web Applications



Genebank Dashboard (Android/ iOS)



PGR Portal



PGR Map



PGR NHCP



Crop Wild Relatives



IP GR (Android)



IP PGR



CRP Agrobiodiversity



MTS Database



PGR Map (Android/ iOS)



Genebank Dashboard



PGR Clim



Genetic & Genomic Resources



FGB Database

exploration and extraction) diverse information (facts, figures, statistics, knowledge and news). To cater to internal requirements and to keep up with spirit of international instruments of information sharing, NBPGR has developed in-house information systems.

Ninth Session of the Governing Body (GB9) of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) — A 6 day GB9 session of ITPGRFA was inaugurated by the Union Minister of Agriculture & Farmers' Welfare, Shri Narendra Singh Tomar in New Delhi on September 19, 2022. More than 400 eminent scientists and resource persons from 150 member-countries participated.



Maize (*Zea mays*) 3-4 cobs/plant and early maturing IC0524594 (INGR13054) (INGR13054)



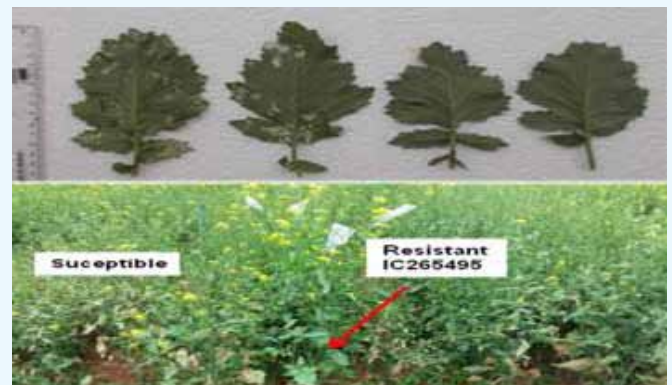
Pearl millet (*Pennisetum glaucum*) high popping yeild IC283734 (INGR13056)



Cucumber (*Cucumis sativus*) carotenoid rich IC210421 (INGR09051)



Chickpea (*Cicer arietinum*) upright podding IC486088 (INGR13058)



Indian mustard (*Brassica juncea*) white rust resistant IC0265495 (INGR18032)

Some trait-specific germplasm identified by ICAR-NBPGR

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.
- Collection in partnership mode, trait-specific germplasm for tolerance to biotic and abiotic stresses and quality characteristics.
- Harmonizing multitude stakeholders including private seed sector, farming community, NGOs and international agriculture research centres to enhance conservation and utilization
- Taxonomic and biosystematic studies of Indian taxa using morphological and molecular tools.
- Comprehensive evaluation of conserved germplasm, establishment of core/ mini-core/reference set of large germplasm collection, identification of potential donor germplasm for agronomic, stress-related and quality traits for genomics assisted trait discovery and enhanced utilization.
- Strengthening of the National Genomic Resources Repository, genomic resource generation and conservation.
- Adoption of all the forthcoming technologies to maximize accuracy, coverage and efficiency of germplasm collection, economize and rationalize germplasm conservation, identify trait-specific germplasm and promote utilization, add value to

germplasm based on genomic and geographical information, develop decision support system to manage PGR

- Develop and implement strategies to comply with international and national legal requirements ensuring easy access and fair benefit sharing
- Develop human resource in PGR and attract researchers to PGR science

Awards and recognitions — Recently ICAR-NBPGR has been ranked 2nd among the 93 ICAR institutes for the years 2019-20 and 2020-21. The Bureau has the distinction of receiving “Best Institute of ICAR” award for the year 1997 in recognition of its dedicated and meritorious service to the nation in the field of PGR augmentation, exchange, quarantine, characterization, utilization, distribution and conservation, and developing a network for efficient management of PGR in the country. NBPGR has also been recognized as a Centre of Excellence for training on in vitro conservation and cryopreservation for APO Region. The activities of human resource development will continue in various aspects of PGR management with special emphasis on biosystematics, in-vitro conservation and cryopreservation, DNA fingerprinting, molecular detection of pests and policy issues related to PGR.

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SPECTRUM

ICAR-DMAPR bags best display award

ICAR-Directorate of Medicinal and Aromatic Plants Research (ICAR-DMAPR), Anand, Gujarat showcased

the technologies on Medicinal and Aromatic Plants at *Guravi Gujarat 2022* held at the Rajwanshi Hotels and

