



## An Inventory of Plant Genetic Resources Repository: National Herbarium of Cultivated Plants

Anjula Pandey, K Pradheep, KC Bhatt, RK Pamarthi, Rita Gupta,  
Ankur Tomar, Pankaj Kumar Kannaujia and SP Ahlawat

Division of Plant Exploration & Germplasm Collection  
ICAR-National Bureau of Plant Genetic Resources, New Delhi 110012, India



# An Inventory of Plant Genetic Resources Repository: National Herbarium of Cultivated Plants

Anjula Pandey, K Pradheep  
KC Bhatt, RK Pamarthi  
Rita Gupta, Ankur Tomar  
Pankaj Kumar Kannaujia  
SP Ahlawat

**Citation:** Anjula Pandey, K Pradheep, KC Bhatt, RK Pamarthi, Rita Gupta, Ankur Tomar, Pankaj Kumar Kannaujia and SP Ahlawat (2022) An Inventory of Plant Genetic Resources Repository: National Herbarium of Cultivated Plants. ICAR-National Bureau of Plant Genetic Resources, New Delhi, India, 36p + i-xii

**Technical support:** Ankur Tomar and Rita Gupta

**Cover page photo identity:** (clockwise) collecting herbarium specimen; commonly used equipments used in herbarium preparation; digitization and scanning of the specimens

**Published by:**

The Director  
ICAR-National Bureau of Plant Genetic Resources  
New Delhi-110 012, India

© 2022

ICAR-National Bureau of Plant Genetic Resources,  
New Delhi-110 012, India

**Contact**

**Dr. Ashok Kumar**

Director  
ICAR-National Bureau of Plant Genetic Resources,  
Pusa, New Delhi-110012  
India

**E-mail:** [director.nbpr@icar.gov.in](mailto:director.nbpr@icar.gov.in)

**Disclaimer:** This document is an outcome of work done at NHCP and technical contents are based on previously published works brought out by the National Herbarium of Crop Plants (NHCP). No part of the content or information should be taken without prior permission of the ICAR-National Bureau of Plant Genetic Resources (ICAR-NBPGR), New Delhi.

-

## ***About the book-----***

The National Herbarium of Cultivated Plants (NHCP) at Indian Council of Agricultural Research-National Bureau of Plant Genetic Resources (ICAR-NBPGR), New Delhi is the herbarium solely dedicated to cultivated plants in India. The NHCP is actively engaged in the build-up, maintenance and collection of herbarium specimens mainly of the cultivars including landraces and less-known species, potential taxa related to PGR&FA and the crop wild relatives.

The book entitled “An Inventory of Plant Genetic Resources Repository: National Herbarium of Cultivated Plants” aims primarily to bring out the historical journey and importance of the National Herbarium of Cultivated Plants (NHCP), methods and trends of use and utilization of specimens with associated data in serving other fields of science in a broader way. This document was a long-awaited publication from the NHCP, dealing briefly with total holdings in herbarium repository and their use in future. The contents of the document include five chapters and two annexures. Chapter 1 provides brief introduction to the National Herbarium of Cultivated Plants (NHCP), New Delhi; chapters 2 and 3 details on ‘Collections and the Status of ‘specimens’, and some significant contributions respectively. Chapter 4 mainly deals with herbarium techniques followed in NHCP. In chapter 5 brief about the services provided by the NHCP followed by an ‘Overview’ to sum up with thrust areas in chapter 6.

An urge to bring this document was felt to revisit this state-of-the art facility to bring it to public domain to serve various fields of basic and applied fields of science, teaching and extension. While preparing this document, it has been kept in mind to set a simple format for better understanding by the wide users including the PGR workers. We express our gratitude and extend sincere thanks to Dr. Ashok Kumar, Director, ICAR-National Bureau of Plant Genetic Resources, for his support in bringing out this document. We wish to thank Dr. E. Roshini Nayar, the former Curator, National Herbarium of Cultivated Plants (NHCP) for her contribution in developing this herbarium to a global recognition. We greatly acknowledge the staff of various regional stations, especially Thrissur, Kerala and Base Centre Cuttack, Odisha for depositing the ‘valuable’ and ‘type’ materials especially of *Curcuma*, *Momordica* and *Abelmoschus*.

Contribution of staff of the Division of Plant Exploration and Germplasm Collection and the Heads of the Division, ICAR-NBPGR, New Delhi and Officer-in-Charges of ICAR-NBPGR Regional Stations for depositing valuable specimens. Acknowledgements are due to all colleagues in the ICAR-NBPGR who have been associated with the activity of build-up of NHCP since its inception, and development. Thanks are also due to the collectors who have surveyed across length and breadth of the nation, studied and submitted the specimens for preservation in NHCP. Late Dr HB Singh, the former Head, Plant Introduction Division, Late Dr. RK Arora, the former Head of the Division, Exploration and Germplasm Collection and Late Dr KPS Chandel, former OIC, NFPTCR Unit, and Sh PP Khanna, former Head Conservation will always be remembered for laying foundation of this herbarium and strengthening the same. The authors hope that this document would serve a useful reference for the researchers, teachers and students especially in the areas of plant taxonomy and systematics with special reference to the crop taxa.

**New Delhi**

**Authors**

Sl. no	CONTENTS	Pg. no.
<i>About the book .....</i>		
1	Brief About National Herbarium of Cultivated Plants (NHCP)	1-7
2.	Holdings of Unique Repository	8-16
3.	Some Significant Contributions and Success Stories	17-21
4.	Techniques for Preparing Herbarium Specimens	22-28
5.	NHCP in Service of PGR	29-30
6.	Present and Future Prospects	31-32
7.	Selected Readings/ References Cited	33-36
<i>Annexures</i>		i-xii

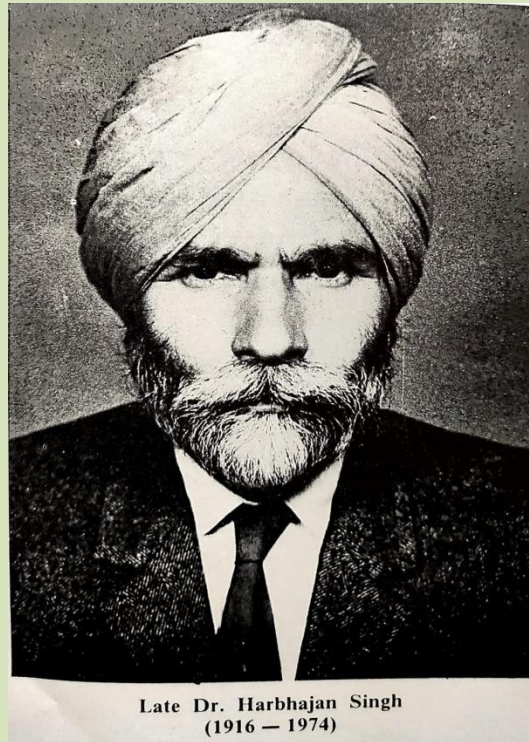
## Introduction

Global herbaria include large representation of vascular plants in the form of herbarium resources of flora and economic taxa, whereas regional/ national flora have rich representation of cultivated plants (cultivated ornamentals). Among the cultivated plant herbaria, The Gatersleben Herbarium (GAT) located in the Department of Genebank of the Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) is one of the largest specialized herbaria which serve as a source of reference for accessions maintained in genebank and other institutional research programmes. Over 4.30 lacs specimens of cultivated plants and its wild relatives, seed and fruit collection (about 1 lac samples) and the spike collection (55,000 samples) are well represented. The holdings include mainly the vascular plant species of Europe and the Mediterranean and the temperate region, eastern and middle Asia, Mongolia and Cuba accessible to wide users.

Global herbarium resources consist of approximately 4,000 recognized herbaria collectively holding over 35,00,00,000 herbarium specimens. India represents over 3.5 million herbarium specimens including over 23,000 type specimens (source: <http://sciweb.nybg.org/science2/IndexHerbariorum.asp>).

The National Herbarium of Cultivated Plants (code 'NHCP') (erstwhile the Herbarium of Plant Introduction Division at Indian Agricultural Research Institute, New Delhi) is a national repository located at ICAR-National Bureau of Plant Genetic Resources, New Delhi. It was shifted to its present location with original holdings as base collection. It occupies an important place among the 25 major Indian herbaria (Singh, 2010; Nayar et al., 2014). It is listed in the Index Herbarium which is a global directory of public herbaria in different regions (Holmgren and Holmgren, 1998; <http://sciweb.nybg.org/science2/IndexHerbariorum.asp>). The collections are mainly of cultivated taxa and wild relatives/ weedy relatives of both native and exotic origin, and plants of potential value identified through plant genetic resource (PGR) programme. In addition local flora of Delhi, weed flora, voucher deposited are well represented. Besides, seed and carpological samples/ economic products of plant genetic resources (PGR) relevance serve as complementary collections.

**Box 1.1 Late Dr HB Singh, The foundation of the Herbarium of Cultivated Plants  
(earlier named as IARI Herbarium)**



Among other major contributors Sh PP Khanna; Drs KPS Chandel, RK Arora and ER Nayar were instrumental in significantly contributing towards the development and build-up of the NHCP facilities and holdings.

Since its inception in 1976 at the Division of Plant Introduction at Indian Agricultural Research Institute (IARI), New Delhi, this herbarium has been directly or indirectly involved in contributing towards various research programmes and thereby strengthening the genetic resources activity in the country. After establishment of the National Bureau of Plant Genetic Resources (NBPGR), New Delhi, the NHCP came up as a full-fledged facility affiliated to the Division of Plant Exploration and Germplasm Collection in 1986-87. NHCP preserves a working collection for material/studies related to plant genetic resources (PGR) programmes and serves as an important tool as reference collection for identification, taxonomic study. Studies on distribution patterns of diversity, and habitat preferences; identifying plant species in the field; referral resources for economic and potentially important plants of India, both indigenous and



exotic in the study of crop plant taxonomy and systematics related uses in taxa, crop evaluation and monographic works on cultivated plant taxa, and identification and validation of taxa have contributed towards PGR science. The holdings well depict variation in crops cultivated on a commercial or local scale including cultivars, species grown in kitchen gardens or as backyard cultigens, used by local communities/ tribals including ethno botanically important taxa; wild relatives of crop plants and weedy species; and wild useful taxa deserving potential as domesticates or identified novel uses. Being a specialized herbarium with emphasis on cultivated plant species and their wild relatives it occupies a greater reference source for PGR programme.

The herbarium differs in its mandate from the existing herbaria across the country with emphasis on variability in crop plants depicted as cultivars, primitive types/ landraces, wild/semi domesticated forms and crop wild relatives (CWR)/ weedy types and also the minor economic species collected from different agro-ecological regions of India under various PGR programmes. The NHCP serves a complementary role to the existing herbarium such as BSI, FRI and NBRI. It maintains links with many ICAR institutes, State Agriculture Universities and traditional universities, Botanical Survey of India (BSI), Forest Research Institute (FRI), and Herbarium Cryptogamae Indiae Orientalis (HCIO- a national-fungal herbarium facility at IARI, New Delhi), and the Herbarium of Wealth of India, CSIR-NISCAIR, New Delhi (ref chapter 5).

System of arrangement of herbarium specimens differs from that of the other herbaria. Here the arrangement of species follow families, then genera and then species; all in an alphabetical order was found more convenient for wide use by PGR workers, para-botanists and non-taxonomists and beginners. For efficient access and use the herbarium resources, documentation and Index Cards of holdings, images as virtual herbarium are included (Nayar *et al.*, 2011). Facilities such as net-house to grow out plants for identification, experimental area for study of taxa and raising material received as seed/propagules), etc. (Pandey *et al.*, 2013) are in place. Guidelines for effective use of the herbarium for consultation/visit to NHCP and identification/authentication of species are published.

The NHCP is aimed to work on crop domestication and development through its mandate of representation of taxa (and variability within them) of over 5,000 crop/economic species reported

(Wealth of India, CSIR, New Delhi), over 320 wild relatives of major crop taxa (Arora and Nayar, 1984) including the rare, over exploited and endangered plants (Arora and Nayar, 1983), and the species introduced every year for breeding purpose.

Over the period of time the published works on cultivated taxa (and variability within them) of crop/economic species (Ambasta *et al.*, 1986; Nayar *et al.*, 2003), wild relatives of major crop taxa (Arora and Nayar, 1984; Pandey *et al.* 2005) and wild edible and economic taxa (Arora and Pandey, 1996) have facilitated identifying the gaps in filling and buildup of material.

### **Historical Perspective**

Traditional herbaria rarely focus on herbarium collections depicting variability within cultivars, primitive forms, landraces, and as also obsolete cultivars. Keeping this in view the Herbarium of Plant Introduction Division of Indian Agricultural Research Institute was reportedly set up in 1948. During 1948-1974 nearly 5,000 specimens were added through collections made under various genetic resource programmes viz. evaluation, breeding and plant introduction. The herbarium was rechristened in 1985 as National Herbarium of Cultivated Plants with its location at the ICAR-National Bureau of Plant Genetic Resources, New Delhi. To lay thrust on building-up of infrastructure facilities work was taken up in project mode in 1985 under institutional project entitled “Establishment, build-up and maintenance of herbarium and seed museum of cultivated plants” under the leadership of Dr. E Roshini Nayar, the former curator of NHCP.

The herbarium staff was trained at various national and international herbaria such as the Royal Botanic Gardens at Kew, and New York Botanical Garden and Arnold Arboretum in USA and various national herbaria in India (Wealth of India Herbarium, New Delhi; Botanical Survey of India and Forest Research Institute, Dehradun and National Botanical Research Institute, Lucknow, Uttar Pradesh) facilitated in upgradation of infrastructure.

### **Infrastructure**

The traditional pigeonhole cabinets were gradually replaced by modern compactor system/ space savers storage designed for dust proof, light proof storage of specimens arranged in species folders/ genus cover. Use of contact poison is discouraged and applied only in special conditions. Eco-friendly methods such as deep freezer and insect repellent, contact poisons (Nepthelein,

odonil) and desiccants are frequently preferred. With addition of more storage space the storage facility would increase by 50-60000 in next five-year plan.

### **Box 1.2 NHCP: A Specialized Repository of Herbarium Holdings of Cultivated Plants**

- Provides a reference collection of diversity in plant genetic resources including both indigenous and exotic specimens, seeds, photographs and illustrations.
- Undertakes studies on taxonomy, floristics and biosystematics of taxa of India
- Develops and provides aids for identification for field collections/crop-groups.
- Provides identification services and issues authentication certificates for research purpose or referral purpose.
- Establishes and maintains links/liaison with other herbaria, genebanks, knowledge exchange and information.
- Actively undertakes teaching in field of plant taxonomy and herbarium techniques with focus on crop taxa.
- Undertakes need based HRD programmes.



**Fig 1.1** Journey of NHCP from a single room and two pigeonhole almira in the ICAR-NBPGR, the herbarium grew with capacity to hold 40,000 specimens

Since its inception, the NHCP has travelled major milestone activities (Table 1.1) as discussed below:

**Table 1.1. Major milestone activities since the inception and establishment of the herbarium**

Sl. no	Year(s)	Event(s)
1	1948	Herbarium of Plant Introduction Division set up at Indian Agricultural Research Institute (IARI), New Delhi
2	1948-1980	Systematic beginning of various genetic resource programmes viz. evaluation, breeding and plant introduction. Enrichment through- Project on Collection of Fodder Grasses and Forage Legumes from North-western region (1948-86); Grassland Survey Scheme of PL-480 (1960-70s); Flora of Karnataka Project (1980s), etc.
3	1976	Establishment of ICAR-NBPGR; thrust on herbarium activity
4	1985	Herbarium of NBPGR rechristened as 'National Herbarium of Cultivated Plants' with its location at the ICAR-NBPGR, New Delhi with base holdings of 5,000 herbarium specimens.
5	1985-2004	Build-up of facilities; human resource development
6	1999-2005	Programmes on taxonomy, systematic and teaching/trainings under National Agricultural Technology Project (NATP) on Plant Biodiversity
7	2004-2014	State-of-arts facility upgradation; addition of five new-space saver compactors enhancing the capacity to 40,000 specimens
8.	2009-2013	Systematics study on Indian taxa- <i>Allium</i> , <i>Trichosanthes</i> , <i>Amaranthus</i> , <i>Luffa</i>
8	2009-2014	Digitization of herbarium (funding from Department of Science Technology); taxonomy of Indian Taxa- <i>Allium</i> , <i>Trichosanthes</i> , <i>Amarathus</i> , <i>Luffa</i> (under NBPGR project)
9	2011-2014	Strengthening on taxonomy and biosystematics study- <i>Vigna</i> , <i>Cucumis</i> , and <i>Abelmoschus</i> under National Agricultural Innovation Project (NAIP)
10	2017-2021	Developing virtual herbarium; digitization of data, updation and cataloguing; development and android mobile application
11	2018	Launching of web portal of NHCP
12	2019-22	Updation in web-portal with digital images; systematic study on wild <i>Vigna</i> , <i>Lathyrus</i> , <i>Cucumis</i>
13	2022- onwards	Renovation, modernization, electronic display system, labeling with QR codes; strengthening human resources, training younger staff on herbarium methods

## Services

Besides the expert consultation services in field of taxonomy, NHCP is actively involved in providing technical input on identification/ authentication, validation of taxa of PGR relevance. It also provides hands on exercise on herbarium procedures to large number of collage and

school students and researchers especially working in fields of pharmacy, pathology, entomology, breeding, etc. It is linked to the other fields of science especially for seeking identification/authentication of material used for research, studies on host-plant relationship, introduced germplasm, weed science, agronomy, pharmaceae, etc. Revised guidelines are in place for the benefit of different users seeking services provided by the NHCP (Pandey et al., 2015; Annexure 1, 2). Since 1999 this facility is being used teaching courses on plant taxonomy, ethnobotany and economic botany with PG School, ICAR-Indian Agricultural Research Institute, New Delhi.

The NHCP accepts unique and unrepresented genetic resources (as herbarium specimens, seed samples and economic products) and encourages users for depositing vouchers for future reference (ref Chapter 5; Annexure 2).

-----

With the defined mandate of the NHCP, the herbarium specimens are added through collection of specimens/ seeds during explorations undertaken in different agro-ecological zones of India, and/or plants material introduced from abroad under various research and breeding programmes, besides vouchers deposited from plant systematics studies on crop-group(s) and those collected under ICAR collaborative projects.

The arrangement and classification of specimens differs from that in other herbaria in the order of families/genus/species arranged alphabetically. Such system was adopted due to its suitability and use by the para-taxonomists in studies on crop taxa. Emphasis on herbarium holdings of wild, weedy taxa; representation of cultivars, primitive landraces, obsolete cultivars, etc. from unrepresented areas makes this herbarium material /collections unique and important for PGR programmes.

### **Build-up of Herbarium Specimens and Current Holdings**

The National Herbarium of Cultivated Plants (NHCP) presently has 25,590 herbarium specimens representative of 267 families, 1547 genera and 4,384 species (as on October, 2022: Annexure 3b) of important taxa of plant genetic resource (PGR) relevance including over 500 crop taxa and 550 species of crop wild relatives (CWR)/weedy relatives (Pandey *et al.*, 2015; Pandey *et al.*, 2021). Selected 10,000 herbarium sheets of different species/taxa are digitized with database and available on the herbarium website (<http://www.nbpgr.ernet.in:8080/nhcp/>). Important taxa of plant genetic resource (PGR) relevance include over 500 crop taxa and ~700 species of crop wild relatives (CWR)/weedy relatives. Additionally, the collection maintained as seed, fruits, inflorescence and other carpological samples in the museum provides a reference collection of crop, wild and weedy plants. Appendix 2.1 provides the number of specimens in each taxa. Source of augmentation has facilitated in build-up of diversity represented in NHCP (Box 2.1).

Variability represented: collected from exploration localities with high diversity in a group include - wild *Vigna* from north-eastern Himalaya, fodder grasses and forage legumes from north-western areas and peninsular India, and wild alliums from high altitude areas of Uttar Pradesh. Wild relatives of crop taxa, viz. *Vigna sublobata*, *V. mungo* var. *silvestris*, *Abelmoschus tuberculatus*, *Solanum incanum*, *Sesamum prostratum*, *S. laciniatum*, *Oryza* spp. Addition of

landraces of crops under *Oryza*, *Triticum*, *Hordeum*, *Abelmoschus*, *Vigna*, *Moringa*, *Luffa*, *Ocimum*, *Juglans* as herbarium and spike collections made the NHCP an important resource for future studies on crops of India.

Besides herbarium specimens of cultivated plants, some neglected groups: less-known domesticated species viz. *Moghania vestita* (Soh-phlong), *Digitaria* (Raishan), *Coix lacryma-jobi* in north-eastern hills, and others such as *Malva verticillata*, *Inula racemosa*, *Hodgsonia heteroclita*, *Brachiaria mutica*, *Aisandra butyracea* (Cheura), *Adansonia digitata* (Gorakh imli), *Setaria glauca*, *Momordica dioica*, *Allium* spp., rice bean, winged bean, *Vigna vexillata*, and taxa of potential/commercial value are well represented.

Crop wild relatives (CWR): maintained in the NHCP include: *Oryza*, *Sorghum*, *Vigna*, *Cajanus/Atylosia*, *Solanum*, *Abelmoschus*, *Cucumis*, *Luffa*, *Allium*, *Trichosanthes*, *Sesamum*, *Curcuma*, *Piper*, *Amaranthus*, *Melilotus*, *Medicago* and *Trifolium*. Some specialty collections include wild *Vigna* from north-western Himalaya, fodder grasses and forage legumes from north-western areas and peninsular India, and wild *Allium* from high altitude areas of western and eastern Himalaya; and wild triticeae from western Himalaya.

#### **Box 2.1 Source of augmenting herbarium specimens**

- Explorations: in natural and agricultural areas; multi-crop specific explorations and crop-specific explorations for indigenous taxa; taxa with build-up of diversity in India.
- Seed multiplication: seed and planting material: germplasm collected and exchanged as propagules (seed or vegetative forms).
- Vouchers deposited: reference samples/vouchers specimens of species studied under exploration, evaluation, exchange and conservation programmes; through experimental study, identification, authentication, etc .
- Gap analysis: collected and added by staff after gap analysis of information and old records.

Herbarium specimens raised from seeds of exotic origin include those prepared under the Plant Introduction (PI) Scheme operational in the Botany Division of the IARI commenced functioning in 1946. Some important genera/crop-groups represented included *Oryza* from Philippines; *Avena* from Australia; *Brassica* from Canada; *Medicago* from Portugal, Australia; *Trifolium* from Australia, Portugal, UK; *Vicia* from Australia; *Solanum* from USA and Sri

Lanka; *Lycopersicon* from South America; dwarf peaches and *Argopyron* from Australia; and *Agathis*, *Calluna*, *Corynocarpus* from New Zealand (Nayar *et al.*, 2011). This activity is presently continued for very specific material based on gaps in collection, for example *Vigna subterranea*, etc. from Mali.

### Some Significant Collections

Significant material holdings were added under special schemes/projects (period given in parenthesis): intensive germplasm collection missions were undertaken by ICAR-NBPGR that resulted in addition of herbarium specimens. Herbarium specimens gathered during special programmes were: Grassland Survey Scheme of PL-480 (1960-70s); Project on Collection of Fodder Grasses and Forage Legumes from North-western region (1948-86); Grassland Survey, Karnataka Flora Project (1980s); National Agricultural Technology Project (NATP) on Plant Biodiversity (1999-2005); Sub-project on Biosystematics of the genera- *Vigna*, *Cucumis*, and *Abelmoschus* under National Agricultural Innovation Project (NAIP) (2011-14); Herbarium of Dr YS Rao's Collection on Aquatic Plants (1948-1986).

**Table 2.1.** Family-wise holdings (specimen no.) in NHCP

<b>Specimens above 400 (no.)</b>	Poaceae, Fabaceae
<b>399-200</b>	Asteraceae, Rosaceae
<b>199-100</b>	Lamiaceae, Cucurbitaceae, Acanthaceae, Solanaceae, Euphorbiaceae
<b>99 and below</b>	Cyperaceae, Malvaceae, Rubiaceae, Brassicaceae, Zingiberaceae, Moraceae, Apiaceae, Verbenaceae, Amaranthaceae, , Polygonaceae, Caesalpiniaceae, Scrophulariaceae, Ranunculaceae, Alliaceae, Mimosaceae, Myrtaceae, Convolvulaceae, Chenopodiaceae, Rutaceae, Liliaceae, Tiliaceae, Piperaceae, Apocynaceae, Orchidaceae, Caryophyllaceae, Oleaceae, Araceae, Asclepiadaceae, Boraginaceae, Vitaceae, Lauraceae, Anacardiaceae, Plantaginaceae, Bignoniaceae, Rhamnaceae, Gentianaceae, Sapindaceae, Dioscoreaceae, Pedaliaceae, Linaceae, Hydrocharitaceae

### Supplementary collections

The herbarium holdings with supplementary material in the form of seed and carpological samples of selected taxa serve as a reference collection for identification, taxonomic study and



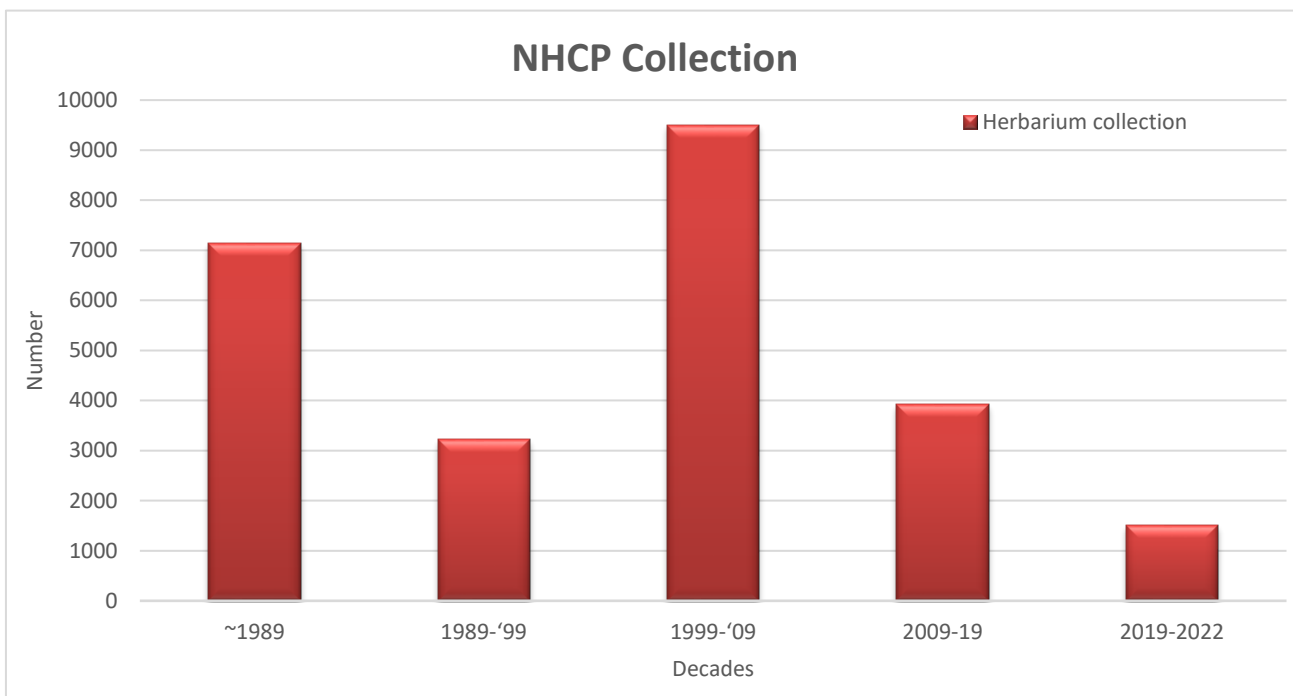
for teaching. Seed collection (3,181) and carpological samples (756 samples) are maintained as complementary collection in NHCP. Seed samples are maintained in plastic boxes in dry form depicting species under genus: *Oryza*, *Vigna*, *Phaseolus*, *Pisum*, *Cicer*, *Solanum*, *Moringa*, *Cucurbita*, *Capsicum*, *Trichosanthes*, *Momordica*, *Allium*, *Luffa*, *Brassica*, *Sesamum*, *Ricinus*, *Gossypium*, *Crotalaria*. Collections are maintained as bulky herbarium (wet preservation or dry form). Some significant ones include- *Lagenaria siceraria* (90cm long fruit; dry fruits as decorative items); five taxa of *Luffa* (dry fibrous fruit), *Entada phaseoloides* (pod 60 cm; seed; stem); *Moringa oleifera* (fruit and seed collection of cultivated and wild types); *Musa babisiana* (inflorescence and fruits); *Juglans regia* and *Prunus amygdalus* (fruits), coconut (fruit, coir); arecanut (fruit, plates made from spathe); *Ravenala madagascariensis* (inflorescence); *Trapa bispinosa* (dry fruit); *Diospyros* (fruits of four species); *Aleurites moluccana* (nuts); *Glycyrrhiza glabra* (roots), *Moghania vestita* and *Pachyrrhizus erosus* (tubers), sorghum and okra (landrace diversity as inflorescence and fruit); *Gossypium arboreum* (bolls of different races); *Triticum* and related taxa (species diversity as spike); *Curcuma*, ginger (rhizome); *Pandanus odoratissimus* (male inflorescence); *Sassurea lappa* (rootstock); *Tecomella undulata* (bark), *Commiphora mukul* (gum crystals), *Saraca indica* (fruits); *Garcinia gummi-gutta*/ kokam (fruits) and *Terminalia* (species diversity as fruit).

Less-known/neglected groups: less-known domesticated species, viz. *Flemingia procumbens* Roxb.(Soh-phlong), *Digitaria compacta* (Roth ex Roem. & Schult.) Veldkamp (raishan), *Coix lacryma-jobi* L. from north-eastern hills; *Malva verticillata* L., *Inula racemosa* Hook.f, *Hodgsonia heteroclita* (Roxb.) Hook.f. & Thomson, *Brachiaria ramosa* (L.) Stapf, *Diploknema butyracea* (Roxb.) H.J.Lam (cheura), *Adansonia digitata* L. (gorakh imli), *Pennisetum glaucum* (L.) R.Br., *Momordica dioica* Roxb. ex Willd., *Allium* spp., *Vigna umbellata* (Thunb.) Ohwi & H. Ohashi (rice bean), *Psophocarpus tetragonolobus* (L.) DC. (winged bean), *Vigna vexillata* (L.) A. Rich. (tuber cowpea), *V. subterranean* and several taxa of potential/commercial value are well represented.

Important taxa of crop wild relatives (CWR) maintained in the NHCP include species under genus: *Abelmoschus*, *Allium*, *Amaranthus*, *Cajanus*, *Cucumis*, *Curcuma*, *Luffa*, *Medicago*, *Melilotus*, *Oryza*, *Piper*, *Sesamum*, *Solanum*, *Sorghum*, *Trichosanthes*, *Trifolium*, *Ziziphus* and *Vigna*. Some significant collections include wild *Vigna* from north-western Himalaya and fodder grasses and forage legumes from north-western areas and peninsular India, and potential wild

*Allium* from high altitude areas of western and eastern Himalaya; wild Triticeae from western Himalaya.

Year-wise holdings of herbarium specimens maintained in the NHCP (as on October 31, 2022) are given in Figure 2.1).



**Fig. 2.1.** Year-wise holdings of herbarium specimens, seed samples and economic products maintained in the NHCP (October 2022)

Some of the archival records include *Eragrostiella bifaria* (Vahl) Bor (HS3007) collected from the Delhi ridge area (10.9.1939 by Dr. HB Singh), *Indigofera colutea* (Burm.f.) Merr. (HS5390, the oldest herbarium specimen collected in 1933 from Quetta, Balochistan, now in Pakistan), *Vicia hyaeniscyamus* Mouterde (HS8539, exotic material raised in Plant Quarantine Experimental Fields, ICAR-NBPGR, New Delhi).

Type collections: newly described taxa by ICAR-NBPGR are some valuable collections maintained in NHCP. The NHCP holds 'type' specimens housed along with the protologue (original description by the author(s)). Each taxa has QR code to facilitate least handling while searching. ICAR-NBPGR has described a total of 21 species/ taxa belonging to 8

genera and 5 families, including 47 ‘type’ specimens (24 specimens of new taxa deposited with NHCP; and 23 in other Indian and foreign herbaria (Annexure 3a).

**Box 2.2. NHCP: Guidelines for Maintenance**

- Routinely attend to the herbarium collections; check order of placement of specimens by random examination.
- Regularly inspect storage spaces/compacters and examine status of quality of herbarium specimens.
- Provide routine curation/ treatment to specimens with utmost care to specimens belonging to families that are more sensitive to storage. While consulting, first examine digital images of ‘herbarium’ before referring to the original material.
- Pay utmost attention to carefully handle ‘Type’ collections housed separately in a herbarium.
- Permit intended users of ‘type’ material on special request.

The holdings in eight genera viz. *Abelmoschus*, *Cucumis*, *Curcuma*, *Herpetospermum*, *Momordica*, *Piper*, *Trichosanthes* and *Vigna* are represented and preserved at NHCP. List of new taxa as ‘type’ with herbarium number, plant family, ‘type’ category are provided (Annexure 3a).

Rare Endangered and Threatened Taxa (RET): by virtue of priority for unique material, the RET were focused for collection as herbarium. Over 140 species under 100 genera are represented under the category of rare/endangered taxa (RET)- *Cycas beddomei* Dyer, *Podophyllum hexandrum* (Royle) T.S. Ying (anti-cancer plant) (refer Appendix 2.1).

Genus	Species	Author
1. <i>Allium</i>	<i>fasciculatum</i>	Rendle
2. <i>Allium</i>	<i>negianum</i>	A.Pandey et al.
3. <i>Allium</i>	<i>stracheyi</i>	Baker
4. <i>Clerodendrum</i>	<i>serratum</i>	Wall. ex Nees
5. <i>Clerodendrum</i>	<i>colebrookianum</i>	Majumdar
6. <i>Commiphora</i>	<i>wightii</i>	R.Br. ex Wall.
7. <i>Coptis</i>	<i>teeta</i>	(L.) Verdc.
8. <i>Costus</i>	<i>speciosus</i>	L.
9. <i>Crocus</i>	<i>sativus</i>	(L.) Hepper
10. <i>Cucumis</i>	<i>hystrix</i>	L.
11. <i>Cucumis</i>	<i>silentvalleyi</i>	(Retz.) Nees
12. <i>Cucumis</i>	<i>prophetarum</i>	(Burm.f.) Stapf & C.E.Hubb.
13. <i>Curculigo</i>	<i>orchioides</i>	Roxb. ex Roth
14. <i>Curcuma</i>	<i>caesia</i>	(Roxb.) H.Karst.
15. <i>Curcuma</i>	<i>angustifolia</i>	L.
16. <i>Curcuma</i>	<i>zerumbet</i>	Roxb.
17. <i>Curcuma</i>	<i>pseudomontana</i>	J.Graham
18. <i>Dactylorhiza</i>	<i>hatagirea</i>	DC.
19. <i>Daphne</i>	<i>papyracea</i>	(L.) Willd.
20. <i>Delphinium</i>	<i>denudatum</i>	Siebold ex Van Houtte
21. <i>Eclipta</i>	<i>prostrata</i>	(Lam.) Willd.
22. <i>Embelia</i>	<i>tsjeriam-cottam</i>	(L.) Dunal
23. <i>Embelia</i>	<i>ribes</i>	(L.) Dunal
24. <i>Enicostema</i>	<i>verticillatum</i>	L.
25. <i>Enicostema</i>	<i>axillare</i>	L.
26. <i>Ensete</i>	<i>superbum</i>	(L.) Ker Gawl.
27. <i>Eryngium</i>	<i>foetidum</i>	Baker
28. <i>Euonymus</i>	<i>tingens</i>	L.
29. <i>Eurya</i>	<i>acuminata</i>	N.Q.Ng
30. <i>Fagopyrum</i>	<i>gracilipes</i>	(L.) A.Rich.
31. <i>Ferula</i>	<i>assa-foetida</i>	L.
32. <i>Flacourtia</i>	<i>indica</i>	L.
33. <i>Fritillaria</i>	<i>roylei</i>	Engl. & Krause
34. <i>Garcinia</i>	<i>gummi-gutta</i>	(L.) Roxb.
35. <i>Gentiana</i>	<i>kurroo</i>	(Roxb.) Planch. ex Thwaites
36. <i>Geum</i>	<i>sikkimense</i>	Prain
37. <i>Ginkgo</i>	<i>biloba</i>	L.
38. <i>Gloriosa</i>	<i>superba</i>	L.
39. <i>Gnetum</i>	<i>ula</i>	L.
40. <i>Goodyera</i>	<i>repens</i>	A.Juss.
41. <i>Gymnema</i>	<i>sylvestre</i>	L.
42. <i>Haloxylon</i>	<i>salicornicum</i>	(Willd.) Kerguelen
43. <i>Hedychium</i>	<i>spicatum</i>	L.
44. <i>Hedychium</i>	<i>coronarum</i>	(L.) DC.
45. <i>Heracleum</i>	<i>rigens</i>	Wall. ex DC.

46. <i>Hippophae</i>	<i>tibetana</i>	Schltld.
47. <i>Holboellia</i>	<i>latifolia</i>	Wall.
48. <i>Holostemma</i>	<i>ada-kodien</i>	Schult.
49. <i>Homalomena</i>	<i>aromatica</i>	(Spreng.) Schott
50. <i>Hydnocarpus</i>	<i>alpina</i>	Wight.
51. <i>Hydnocarpus</i>	<i>kurzii</i>	(King) Warb.
52. <i>Hydnocarpus</i>	<i>pentandrus</i>	(Buch.-Ham.) Oken
53. <i>Hyoscyamus</i>	<i>niger</i>	L.
54. <i>Hyssopus</i>	<i>officinalis</i>	L.
55. <i>Indigofera</i>	<i>tinctoria</i>	L.
56. <i>Inula</i>	<i>racemosa</i>	Hook.f.
57. <i>Jurinea</i>	<i>dolomiaea</i>	Boiss.
58. <i>Jurinea</i>	<i>macrocephala</i>	(DC. ex Royle) C.B.Clarke
59. <i>Kaempferia</i>	<i>galanga</i>	L.
60. <i>Knema</i>	<i>attenuata</i>	(Hook.f. & Th.) Warb.
61. <i>Lilium</i>	<i>polyphyllum</i>	(Molina) Standl.
62. <i>Linum</i>	<i>perenne</i>	R.Br.
63. <i>Lycopodium</i>	<i>clavatum</i>	(Miq.) C.DC.
64. <i>Madhuca</i>	<i>longifolia</i>	L.
65. <i>Mahonia</i>	<i>napaulensis</i>	(Molina) Standl.
66. <i>Malaxis</i>	<i>versicolor</i>	Schard.
67. <i>Meconopsis</i>	<i>aculeata</i>	Fisch.
68. <i>Megacarpaea</i>	<i>polyandra</i>	D.Don
69. <i>Mesua</i>	<i>ferrea</i>	L.
70. <i>Mimusops</i>	<i>elengi</i>	(Thunb.) Matsum. & Nakai
71. <i>Morina</i>	<i>longifolia</i>	Wall. ex DC.
72. <i>Morinda</i>	<i>citrifolia</i>	(L.) Voigt
73. <i>Moringa</i>	<i>concanensis</i>	Nimmo
74. <i>Nilgirianthus</i>	<i>ciliatus</i>	Benth. ex Bedd.
75. <i>Olea</i>	<i>europaea</i>	L.f.
76. <i>Onosma</i>	<i>echioides</i>	(Burm.f.) Wight & Arn.
77. <i>Orchis</i>	<i>latifolia</i>	L.
78. <i>Origanum</i>	<i>vulgare</i>	L.
79. <i>Paeonia</i>	<i>emodi</i>	(L.) DC.
80. <i>Paris</i>	<i>polyphylla</i>	L.
81. <i>Picrorhiza</i>	<i>kurroa</i>	L.
82. <i>Picrorhiza</i>	<i>scrophulariiflora</i>	Medik.
83. <i>Piper</i>	<i>longum</i>	L.
84. <i>Piper</i>	<i>mulesua</i>	L.
85. <i>Piper</i>	<i>peepuloides</i>	(L.) Schott
86. <i>Pleurospermum</i>	<i>densiflorum</i>	(Lindl.) Benth.ex CB Clark
87. <i>Podophyllum</i>	<i>hexandrum</i>	L.
88. <i>Podophyllum</i>	<i>peltatum</i>	D.Don
89. <i>Polygonatum</i>	<i>cirrhifolium</i>	Nees
90. <i>Polygonatum</i>	<i>verticillatum</i>	(L.) Skeels
91. <i>Psoralea</i>	<i>corylifolia</i>	(Buch.-Ham.) DC.
92. <i>Pueraria</i>	<i>tuberosa</i>	L.
93. <i>Rauvolfia</i>	<i>serpentina</i>	L.

94. <i>Rheum</i>	<i>moorcroftianum</i>	Desv.
95. <i>Rhododendron</i>	<i>campanulatum</i>	(Wight & Arn.) Kurz
96. <i>Rhododendron</i>	<i>anthopogon</i>	(Roxb.) W.J.de Wilde
97. <i>Rhododendron</i>	<i>lepidotum</i>	Kurz
98. <i>Roylea</i>	<i>cinerea</i>	(D. Don) Baillon
99. <i>Ruta</i>	<i>graveolens</i>	L.
100. <i>Santalum</i>	<i>album</i>	Willd.
101. <i>Saraca</i>	<i>indica</i>	L.
102. <i>Saussurea</i>	<i>obvallata</i>	L.
103. <i>Saussurea</i>	<i>lappa</i>	L.
104. <i>Saussurea</i>	<i>costus</i>	L.
105. <i>Schisandra</i>	<i>grandiflora</i>	L.
106. <i>Schleichera</i>	<i>oleosa</i>	L.
107. <i>Selinum</i>	<i>tenuifolium</i>	(Willd.) Miers ex Hook.f. & Thomson
108. <i>Selinum</i>	<i>vaginatam</i>	L.
109. <i>Skimmia</i>	<i>laureola</i>	L.
110. <i>Smilax</i>	<i>wightii</i>	(Jacq.) Marechal
111. <i>Smilax</i>	<i>zeylanica</i>	(Jacq.) Marechal
112. <i>Stevia</i>	<i>rebaudiana</i>	(B.Heyne ex Wight & Arn.) Tateishi & Maxted
113. <i>Strychnos</i>	<i>nux-vomica</i>	(L.) Medik.
114. <i>Strychnos</i>	<i>potatorum</i>	Pal & Har B.Singh
115. <i>Swertia</i>	<i>chirayita</i>	Wall.
116. <i>Symplocos</i>	<i>racemosa</i>	(L.) Moench
117. <i>Tanacetum</i>	<i>nubigenum</i>	Ortega
118. <i>Tanacetum</i>	<i>longifolium</i>	K. Pradheep et al.
119. <i>Taxus</i>	<i>baccata</i>	(Kuntze) Verdc.
120. <i>Thalictrum</i>	<i>foliolosum</i>	Medik.
121. <i>Trichosanthes</i>	<i>dunniana</i>	Griff.
122. <i>Trichosanthes</i>	<i>anaimalaiensis</i>	L.
123. <i>Trillium</i>	<i>govanianum</i>	Thouars
124. <i>Tubocapsicum</i>	<i>anomalum</i>	Roxb. ex Willd.
125. <i>Typhonium</i>	<i>diversifolium</i>	Singh & Bhandari
126. <i>Urginea</i>	<i>indica</i>	(Hemsl.) C.K.Schneid.
127. <i>Uvaria</i>	<i>narum</i>	(L.) L.
128. <i>Valeriana</i>	<i>wallichii</i>	Retz.
129. <i>Valeriana</i>	<i>jatamansi</i>	(L.) Sweet
130. <i>Vanilla</i>	<i>wightiana</i>	Lindl.
131. <i>Vateria</i>	<i>indica</i>	L.
132. <i>Vernonia</i>	<i>cinerea</i>	(L.) G.Don
133. <i>Vitex</i>	<i>trifolia</i>	L.
134. <i>Withania</i>	<i>coagulans</i>	L.
135. <i>Woodfordia</i>	<i>fruticosa</i>	(L.) R.Wilczek
136. <i>Wrightia</i>	<i>tinctoria</i>	(Kuntze) Verdc.
137. <i>Zanthoxylum</i>	<i>armatum</i>	L.
138. <i>Zanthoxylum</i>	<i>rhetsa</i>	L.
139. <i>Zizania</i>	<i>latifolia</i>	L.

The NHCP has contributed in enhancing and nurturing the field of PGR in many ways. It has provided the base collection of over 25,000 herbarium resources for science in cultivated plants and PGR. Major areas of contribution towards buildup of NHCP material are discussed below under broader headings:

**Taxonomic and Systematic Study:** study was taken up on native crop taxa/ PGR relevance viz. *Oryza*, *Vigna*, *Crotalaria*, *Cajanus/Atylosia*, *Macrotyloma*, *Sesamum*, *Abelmoschus*, *Luffa*, *Trichosanthes*, *Allium*, *Moringa*, and *Ocimum* (Nayar, 2015) to resolved taxonomic and systematic issues. Validation using evidences from biochemical and molecular tools under inter-institutional collaborative research works were done. The NHCP has facilitated in study of crop plants in the Indian region and their wild relatives enumerated by Pradheep *et al.* (2014).

Systematic study was undertaken for establishing identity of newly described taxon - *Herpetospermum operculatum* (Pradheep *et al.*, 2014); *Trichosanthes* (Pradheep *et al.*, 2015); new floristic records (Pradheep *et al.*, 2013); *Momordica* (Soyimchiten *et al.*, 2015); *Nothoscordum gracile*, *Solanum diphyllum* (Pandey *et al.*, 2017); other naturalized taxa (Pradheep *et al.*, 2013). This has also generated voucher material and information associated with herbarium resources.

Indigenous taxa of *Allium* collected across the country were studied for systematic and documented for diversity with genetic resources of Indian *Allium*. Illustrations of 20 taxa (belonging to 7 species) linked with germplasm maintained in NGB and Field genebank, Bhowali, Uttarakhand (Pandey *et al.* 2022).

### Study on Domestication Trends

Range of diversity available in NHCP has facilitated in study on trends of domestication and in understanding the character changes during this process (Pandey *et al.*, 2016; Pradheep *et al.*, 2015). Some taxa like *Allium fasciculatum* reported under cultivation for vegetable from Sikkim and Arunachal Pradesh; *Tupistra clarkeias* vegetable from Sikkim were studied for domestication changes in characters.

Wild economic and potential species of PGR relevance were observed for new uses/new records among the taxa- *Crotalaria tetragona* (tum thang, Bhatt *et al.*, 2009a), *Bidens pilosa* (Bhatt *et al.*, 2009b), *Plukenetia corniculata* (meetha patta), *Ziziphus nummularia* (ber), *Hodgsonia heteroclita*, *Abelmoschus tetraphyllus* (sukhlai) (Pandey *et al.*, 2010, 2011a, b; Semwal *et al.*, 2014; Pandey *et al.*, 2015; Rathi *et al.*, 2016). Eco-geographical evidences on taxa of PGR relevance in NHCP have also supported other research programmes in the institute and facilitating viewing new dimensions to the existing crop gene pool (Pradheep *et al.*, 2011).

### **Development of Protocol for Safe Preservation and Processing Techniques**

Protocol are being worked out and developed for difficult-to-store groups, pest-free storage, ideal storage conditions for families which are sensitive to pest damage, standardization of use of low temperature (-20°C) using deep freezer, dusting of naphthalene powder, etc. Modified traditional methods of “difficult-to-represent taxa” like bulbous group, tuberous/rhizomatous taxa, *Musa*, *Agave*, *Cucumis*/ cucumbers etc. are being work out with intermittent drying with microwave drying techniques (Jain and Rao 1977; Pandey *et al.*, 2013; Pandey *et al.*, 2016a, b). The preservation of material with minimal use of hazardous chemicals was found advantageous in use of material in biosystematics, biochemical/ phytochemical and molecular analysis. To minimize use of contact poisons/chemicals, dusting with insect repellants (naphthalene bolls), and deep freezing methods are preferred.

Observation on preserved herbarium noted differential level of sensitivity: very sensitive families (Cucurbitaceae- *Cucumis*, *Trichosanthes cucumerina*, *Momordica charantia*), *Allium*, Araceae (lamina), Rosaceae (esp. emerging leaves along with inflorescence (*Malus*, *Pyrus*, *Prunus*), leaves in *Brassica* (also *Brassicaceae* in general), *Moringa* and Labiatae (*Ocimum*, *Mentha*). Among the specimens, the best stores included: thick leaved plant families: Arecaceae, Poaceae, Myristicaceae, Anacardiaceae (phenolics richness). In general, those with very thin lamina are prone to insect damage and skeletonising at faster rate.

In addition emphasis is being made on standardization of methodology for processing of specialized groups such as landraces (variation), difficult groups (succulents, large fruited types, aquatic plants, economic/ eco-friendly methods of storage. For difficult groups, field guides for herbarium processing and identification have been published (Pandey *et al.* 2022).



## Documents Published

Information on status of distribution, variability on taxa and localities/regions for collection, exchange and representation of herbarium prepared as baseline data for build-up of material. To achieve the targeted in herbarium collections, the published records are revisited from time to time. Several publications in the form of books, manuals, chapters, and research papers on new geographical distribution have been brought out as a result of study taken up and work done in NHCP. Some important literature and old records have been used: the cultivated taxa (and variability within them) of crop/economic species (Ambasta et al. 1986; Nayar et al. 2003), wild relatives of major crop taxa (Arora and Nayar 1984; Pandey et al. 2005), wild edible plants of India and economic taxa (Arora and Pandey 1996) and the crop wild relatives of India (Pradheep et al., 2013).

Some significant examples of published documents include: Wild Relatives of Crop Plants of India (Arora and Nayar, 1984), Wild Edible Plants of India (Arora and Pandey, 1996), Wild Relatives of Crop Plants- Collection and Conservation (Pandey *et al.*, 2008), Genetic Resources of Rosaceae of India (Pandey *et al.*, 2006) and Guidelines for Use of NHCP ([krishikosh.egranth.ac.in/.../1/2035781](http://krishikosh.egranth.ac.in/.../1/2035781); [krishikosh.egranth.ac.in/.../1/.../1/8.pdf](http://krishikosh.egranth.ac.in/.../1/.../1/8.pdf)) and Importance of Voucher Specimens of Introduced Germplasm (Nayar *et al.*, 2003; 2014). Recently published user guidelines and catalogue of the type specimens in the National Herbarium of Cultivated Plants have facilitated wider access to the users (Pandey et al. 2021).

The work done in project mode on ‘Genetic Resources Study of Economically Important Plant Families- Cucurbitaceae, Malvaceae, Rosaceae and Poaceae’ during 1984-1995 (served as base line for many taxonomic works undertaken in NHCP. Study of crop taxa of Indian region (Asiatic *Vigna*, *Crotalaria*, *Allium*, *Prunus* and wild Triticeae); and check-lists of Indian Crop Plants and Crop Wild Relatives pin-pointed gaps in collection and prioritisation for build-up holdings (Arora and Nayar, 1984; Nayar *et al.*, 2003; Nayar 2015).

Teaching aids: Since the inception of teaching course on PGR in 1999, the herbarium staff played an instrumental role in developing aids in plant taxonomy, exploration and ethnobotany; demonstrating use of tools in identification. Every year, PGR students (Msc. and Ph. D programme) are provided exposure in field training organized visits, lectures and practical exercises to help in understanding the concepts of taxa. For taxonomy teaching the NHCP has

taken a lead to publish document (Pandey et al. 2019). Additionally field identification keys are prepared for - *Vigna*, *Crotalaria*, *Allium*, *Trichosanthes*, *Luffa*, *Malva*, etc. (Pandey and Pandey, 2005; Pandey and Nayar, 1994; Pandey and Bhatt, 2008; Pandey *et al.*, 2014a, 2014c). Visual aids (videos) on methods of identification of plants and demonstration slides are prepared for teaching and demonstration through on-line platform.

Popularize and sensitization: the students and masses visiting the ICAR-NBPGR are being sensitized for use of herbarium specimens (botanical name, family, local name, uses, etc.) with photograph and QR Codes on the plants located in two campuses, for easy access.

### **Some Success Stories**

The NHCP has facilitated research activities on plant genetic resources especially while conducting evaluation and identification of unique trait specific germplasm. Of over a dozen of success stories that have emerged based on herbarium study, some significant ones with leading examples are as follows:

- *Abelmoschus tuberculatus*, a wild relative of cultivated okra was described and evidences from morphological and crossability were established.
- Lentil (*Lens esculentum*) landrace from Rajasthan with very distinct funiculus on the seed coat
- Orange coloured cucumber (*Cucumis sativus*) from Mizoram and Manipur states of north-eastern region of India
- A less-known tuber species ‘Soh-phlong’ (*Moghania vestita*) from Meghalaya
- ‘Arya’ (*Cucumis melo* var. *alwarensis*) from parts of Alwar (Rajasthan) and Rewadi (Haryana)
- Wild relative of wheat, *Aegilops tauschii* from cold desert of Jammu & Kashmir
- Crop wild relatives, wild okra (*Abelmoschus manihot* subsp. *tetraphyllus*) under cultivation for stem used in clearing in jaggery industry

The study on newly described species taxon *Abelmoschus tuberculatus*, a wild relative of cultivated okra (*Abelmoschus esculentus* L.), way back in 1952 was done using seeds collected from Saharanpur, Uttar Pradesh and grown in the Plant Introduction Plot, at Indian Agricultural Research Institute, New Delhi. Identification and description was made of a new taxon-

*Herpetospermum operculatum* from Sikkim known for edible leaf; *Cucumis melo* L. var. *alwarensis* from Alwar, Rajasthan for fruits edible; *Trichosanthes dunniana* subsp. *clarkei* and *A. negianum* from western Himalaya a related species of pointed gourd.

Herbarium, field and grow-out study on wild useful species resulted in attending taxonomy especially the identity related issues in: high altitudes of Himalayan allium (*Allium przewalskianum*, *A. roylei*, *A. stracheyi*) as seasoning spice; *Bidens pilosa* leaves used as medicinal and herbal by the Ladakhi people; *Crotalaria tetragona*, a close relative of sun hemp under wild and less-known cultivated used for edible flowers from Mizoram; *Perilla frutescence* and its weedy relatives from Himalaya; potential tuberous species *Dioscorea esculenta* used in Chhatt Puja in eastern India; less-known cultivated tuber crop, *Moghania vestita* from Meghalaya; a cultivated edible oil species, *Hodgsonia heteroclita* in NEH region; alegume tree species *Parkiaroxburghii* from in NEH region; a wild aromatic species, *Blumealacera* used for preparation of “Umbadyu” in Gujarat; wild spice/condiment, *Arivela viscosa* (*Cleome viscosa*) from Godavari district of Andhra Pradesh.

Floras and literature study resulted in identification of taxa for extended distribution records- *Allium fasciculatum*, *Tubocapsicum anomalum*, *Fagopyrum gracilipes*, *Trichosanthes kerii*, *Trichosanthes majuscula*, *Vigna angularis* var. *nipponensis* from Arunachal Pradesh; *Tupistraclarkei*, *Trichosanthes pilosa*, *Trichosanthes majuscula* from Sikkim; *Momordica subangulata* subsp. *subangulata*, *Juglanssigillata*, *Caryota obtusa*, *Trichosanthes dicaelosperma*, *Trichosanthes anaimalaiensis* from Nagaland; *Amaranthus hybridus*, *Abelmoschu smoschatus*, *Solanum virginianum*, *Corchorusaestuans*, *Bacopamonnierif* from Great Nicobar; *Stahlianthus involucratus*, *Vigna angularis* var. *nipponensis* from Mizoram; *Trichosanthes majuscula* and *Trichosante pilosa* from Assam; *Dioscorea piscatorum* from A&N Islands.

-----

The National Herbarium of Cultivated Plants (NHCP) by virtue of its uniqueness represents an array of diversity in the Indian region and crop plants and their wild and weedy types collected through different plant genetic resources programmes. Addition of an ideally dried herbarium with character representation (vegetative characters: roots, tubers, bulbs and rhizome, leaf, stipule, spine, bark, etc. and floral characters: inflorescence, flower-spathes, scape, stamen, sepal, petal/tepals; and fruit characters: pericarp, placentation, seed) has real resources value in taxonomic studies. Besides, information on plant species with respect to the area of availability, variability pattern, flowering/fruitlet time, status on rare/endangered/endemism, other ecological features, economic uses, indigenous traditional knowledge (ITKs), etc. gathered from herbarium data serves as resource for basic and applied research, referral use and for educational programme. Appendix 4.1 provides details of fields for recording of data associated with herbarium specimen records and herbarium label.

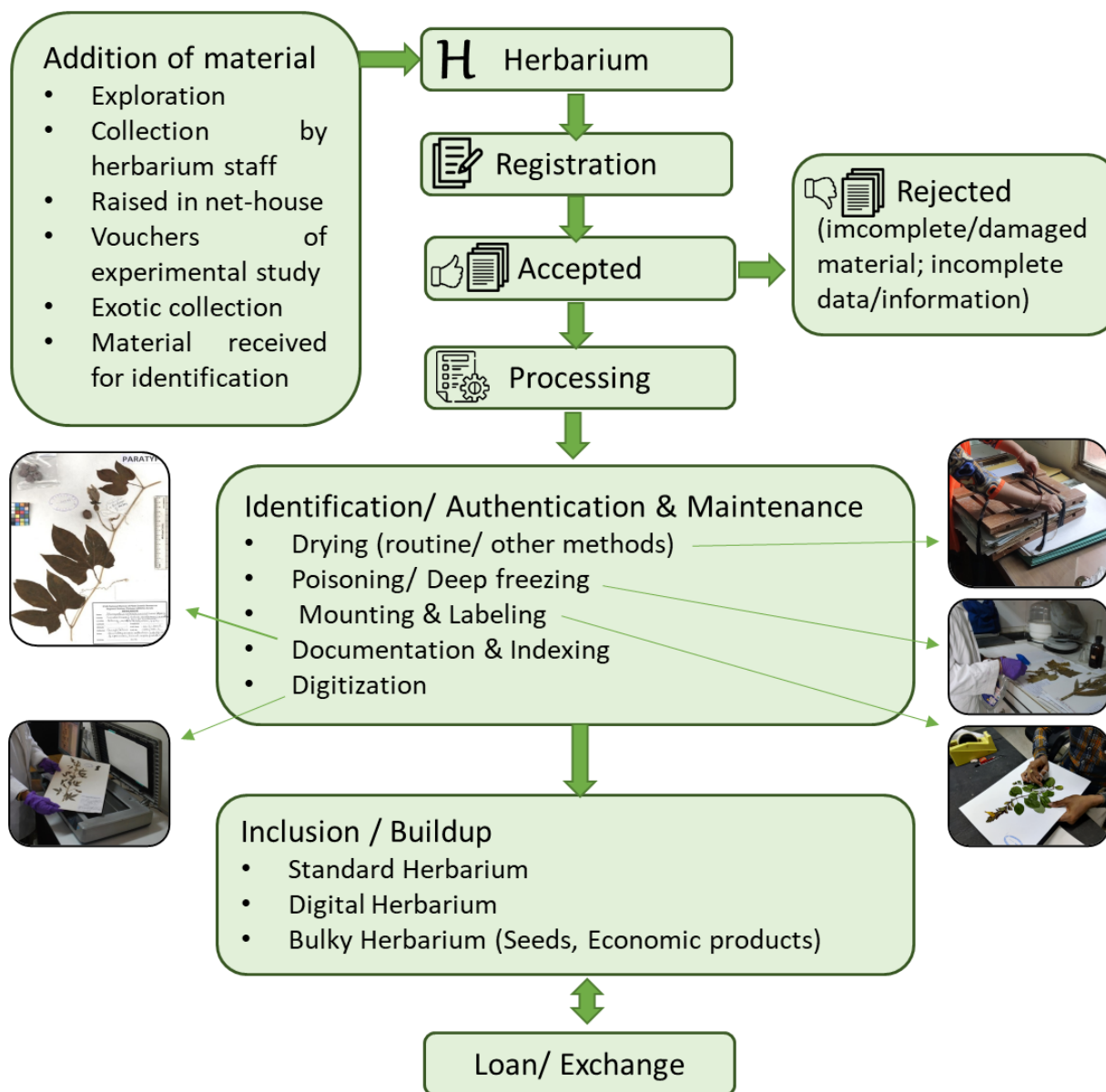
NHCP follows standard traditional as well as refined methodology for processing of the herbarium specimens. Since cultivated plants represented herbarium of range as diversity collections, plant parts are mostly bulky in case of vegetables, fruits, others where processing for drying is very cumbersome, needs special attention modified steps (refer Pandey et al., 2022; Fuller and Barber, 1981). The flow chart depicts the steps involved in inclusion of herbarium specimen in the NHCP (with details followed) (Fig. 4.1).

Plants are collected at random along a zig-zag/diagonal transect, using a strong knife, a pair of pruning shears or secateurs. A collecting pick is used to dig out underground parts. Polythene bags or vascula (metal collecting cans) are also used to collect the material. Delicate plants that tend to wilt fast may be collected and pressed right in the field between blotters. A tag with collector number and date is attached to individual plants while collecting.

The specimen should consist of one or more whole plants complete with roots, stem, leaves, flowers and if possible fruits. Normally the minimum number of specimens in a collection should be two-three but if the plants are small an attempt is made to collect several (at least 5-6) specimens of the same plant from the same locality. Where the plants are shrubs or trees, it is necessary to select a portion as a representative specimen

the size of which is normally determined by the size of the mounting sheet. The following steps are discussed for herbarium specimen preparation in subheads:

### A. Collection and processing of plants



**Fig. 4.1** Flow chart showing processing of species for inclusion in NHCP

When flowers and fruits are too large to be pressed with the leaves, they are kept separately in polythene bags or boxes. Extra specimens of the same collection can be made depending on the requirement; duplicate set if collected may be used for replacing in case of need, for exchange/studies. All additional notes on specimen- as collector's name and collection number, place and date of collection, and features of the plant not

shown by the dried specimen as soil types, associated flora, distribution, etc. should be recorded in the field note book. For RET species, only a small segment of representative plant or observations/ photos should be taken; one should avoid not to disturb the population till it profusely multiplies.

### **Pressing and Drying**

Using absorbent sheets (blotters or newspapers) each specimen is neatly arranged with all plant parts well spread. Care should be taken to avoid overlapping of plant parts. A corrugated sheet is placed between the blotters and the specimen if specimen is to be dried using artificial drying method. The whole bundle is placed in a plant press and tied using a strong belt or strap.

The following points are noted while pressing of herbarium specimen:

- Large specimens should be pruned and folded to the required size giving V or N shape.
- A few leaves should be pressed with lower side up; and flowers split open if gamopetalous.
- A large specimen may be split into two or three parts and pressed separately but with the same number.
- Plants with very large leaves may be represented by a leaf (split or folded) along with some important parts like ligules in bamboos, leaf sheaths in the Araceae, etc. Special notes or outline features may also be enclosed.
- Underground parts that lose their identity on drying may be depicted by photographs/outlines.

### ***Drying Methods***

The herbarium press containing specimens is left tied for 24 hours (sweating period). When first opened, all plant parts are neatly rearranged on fresh absorbent sheets. The bundle with specimens is again put in the press for 24-36 hours. Same process is repeated for about a week or until complete drying is effected. Thick or succulent material require more time. Used blotter sheets may be recycled after drying. Plant specimens are usually processed right in the field or at least the same day, else if left overnight they tend to deteriorate.

Use of artificial heat facilitates quick drying process, no storage fungal/pest growth. Using this method the specimens after processing for 24 hours in field press are rearranged and placed over a heat source (drying chambers, ovens, stoves, etc.). The temperature is adjusted to 46-50<sup>0</sup>C. The heated air passing through the corrugated sheets placed between the blotters with dried specimens. Time taken for drying varies and this procedure may be modified based on type of material. Special techniques are adopted using micro-wave or other fast drying methods. Protocols are routinely developed for cultivated plants with bulky, fleshy fruits, roots, rhizomes or for plants with succulent or fleshy parts.

### ***Preservation***

The specimens are poisoned immediately after collection or at the time of mounting usually by:

- Chemical treatment: using alcohol to avoid the microbial damage under high humidity conditions in the field.
- Fungal protectant: dipping the whole plant in a saturated solution of mercuric chloride in ethyl alcohol and processing the same for drying.
- Wet treatment: an airtight polythene bag is used for treatment of specimen with 10% formalin poured over specimens.
- Preserving mounted specimens: preservation treatment can be used same as above using a brush.

Specimens are fumigated when infestation of pests in high inside the cupboards. Since chemical treatment such as volatile poisonous liquids like carbon disulphide, methyl bromide, carbon tetrachloride pose health hazards one should handled the same with great care. While treating specimens through wet method, fumes the samples should be airtight condition for 3-4 days. In several herbaria nowadays, the specimens are subjected to a period of freezing at -20<sup>0</sup>C, which has proved effective in control of pests/pathogens.

### ***Mounting of Specimens***

Completely dried, poisoned specimens are mounted on good quality, standard-sized mounting sheets/boards (11.5 x 16.5 in). Different materials such as glue, paste, narrow

strips of glued linen, a needle and thread, etc. are used for mounting. The glue or paste is usually applied using a brush. An alternative procedure is to spread the glue over a sheet of glass over which the lower side of the plant is placed before mounting on sheet. Stiff/bulky plant parts are usually tied using needle and thread. The herbarium label (4.5 x 2.75 in) containing information on plant name, family, local name, date of collection, place of collection, collector number, status (flowering/vegetative) should be pasted on the bottom right hand corner with information typed or filled with permanent ink. A paper pouch for extra plant parts may be pasted on the bottom left hand corner.

In herbarium label, the latest accepted name should be filled. Annotation or “determinavit slips” (det.; small slips attached to the herbarium sheet to indicate name changes/correct identity of a plant) and special notes provided by an expert/person, his name and signature with date along with institutional affiliation. They are the source data on any name changes done during subsequent studies.

### **B. Identification of the Plant Specimen**

Identification methods involve study of the plant characters; careful examination and comparison of the characters vis-a-vis the description in the regional floras using family, genus and species keys, and cross matching the same with already available identified specimens. When no clues are available in the regional flora for plants from adjacent regions, larger herbaria, expert opinion or associated data available on the taxon are used as reference material.

### **C. Accessioning and Incorporation of Specimens**

After mounting, labeling and identification, specimens are given a Herbarium Accession Number, a unique identification number (designated as HS number). The herbarium may be arranged in a hierarchical system: Species - genera - family - order and so on; a standard system of classification such as that of Bentham and Hooker, or Engler & Prantl (Lowrence, 1964) is used to organize collection. For easy referal any acceptable system for classification can be used.

The group/species of interest for study can be located in herbarium of cultivated plants (at ICAR-NBPGR) using the following guidelines. A family is separated from the one



above and one below by marker flap (a separator sheet). Genera and species under them are usually arranged alphabetically.

The herbarium sheet on which specimen is mounted records all information about the plant sample. Herbarium label provides basic information on the specimen- location data/natural habitat, date of collection, collector's name, identity, plant use if any, etc. (refere Box 4.1)

### **Maintenance and Storage**

The herbarium holdings should be stored in ideal storage conditions such as low light, dust and light proof and low temperature. During storage serious damage by the storage pests reduces the specimen quality and shelf-life and therefore several health hazards for the users. Routine use of insecticides and the fungicides is now days generally not recommended due to residues cause adverse effects on health. Several alternative methods as fumigation, use of contact poison and deep freezing techniques may help to control storage pests.

Storage units - cupboards (pigeonhole types) or specially designed units (called space savers) are used for housing specimens in light proof and dust proof condition and monitoring is continued on regular basis for maintaining quality material. To save space and maintenance cost, housing the specimens in compactor system is more economical.

### **Digitization**

Digital vs Virtual herbarium: digitized herbarium images of herbarium specimens serve as an important resource for research activities at the institute. The captured digital images are arranged in alphabetical order in family, genus and species folders. The images are labeled with unique identity numbers (as of herbarium specimens) and linked to database (<http://www.nbpgr.ernet.in:8080/nhcp/>). In NHCP digital images for over 4,000 species (~ 10,000 images) of crop plants and their wild relatives and potentially useful plants are available for wide use through virtual herbarium.

Digitization process involves scanning of taxonomically authenticated specimens/taxa, linking digital images of reference herbarium specimen to data and working out on key characters for identification of species (closer view, if needed). Digital scans (jpeg

images) with good resolution (300 dpi for close up of parts-seed, trichomes, and 600 dpi for micro-characters) not only facilitate fast access of material for identification but drastically reduce chances of damage due to routine/mechanical handling.

Presently, herbarium specimens of 298 taxa representing 482 exotic germplasm accessions bearing Exotic Collection (EC) numbers and over 500 of crop wild relatives (CWR) have been uploaded in website for wider use (<http://192.168.5.92/NHCP/Advancesearch.aspx>). This process is a continuous work and the users however can request the scanned images for referral purpose. Refer to the guidelines (Annexure 2)

**Box 4.1: Data for Herbarium Label**

Herbarium Record, NHCP, NBPGR, New Delhi

Botanical Name

Family

Local Name

Loc. (Place, Town, Dist. State)

Date of Collection

Collector's Name and No.

Field Collection/Grown in experimental Conditions:

Identified by

Nature of Specimen (Adult Plant /Seedling, Vegetative/Flowering/Fruiting etc.)

No. of Specimens

Additional Material supplied (Seed, fruit, Economic product) users, if any, in locality of collection

Notes

Herb. specimen No.: 1      2      3      4

-----

NHCP has collection of well identified herbarium specimens with high referral value in teaching, identification/authentication, consultation and resources for research, documentation. Being an important tool in managing PGR activities, identification of specimens, and study of diversity of crops and wild relatives it functions largely in linking with various PGR programmes and herbaria of the region and country. As crop plants are less often studied from the taxonomic point of view collections of cultivated and wild taxa available in NHCP provides the basis for such studies.

In the past the NHCP has broadly provided services (Box 5.1) and has facilitated research in diverse areas of science in general and PGR in particular:

- a) Areas of plant distribution: status report on variability pattern, flowering/fruitletting time, status on rare/endangered/endemic types, etc. in setting their targets. Gap analysis based on existing collection and the diversity available in crop species in India (exotic and indigenous)
- b) Grouping of species: through taxonomic studies and in developing a classification system for plants
- c) Sampling tools: data on rarity, commonness, has fairly close approximation to random sampling for the species in an area.
- c) Providing new evidences: considerable characters preserved in a processed herbarium specimen provide support to morphological evidences, biochemical evidences; macro-morphological traits, the micro-morphological traits (epidermal features- hairs, trichomes; pollen grains) and depositions and chemical constituents (phenolics, alkaloids)
- d) Additional use: voucher specimens of the earlier studies on cytology, chemistry, breeding, and other related fields as entomology, pathology, weed science, palynology, etc. available to subsequent worker for study.
- e) Ethnobotanical studies: base on notes on use of plants collected from tribal/ remote areas for recording/ authenticating and validating on plant novel uses/value.
- f) Connecting links: involvement of curator for maintaining, processing and making available the material for study develops new linkages among herbarium human resources.

- g) Trainings and HRD programmes: demonstration/hands on exercises on herbarium methods for preparation and preservation of fleshy plants, plants highly prone to infestation, large-sized plants, etc.
- i) Teaching: laboratory for understanding taxonomy through hands on research on plants/parts.
- j) Providing information: areas of availability, distribution ranges; nature of diversity known to be available in cultivation and in the wild; identification services
- k) Issue of authentication certificates: activity of authentication of herbarium has been made on payment basis from 2019 (guidelines available -Pandey et al. 2020).

**Box 5.1: Services Provided by NHCP**

S. no.	Services	No of Indenters
1.	Identification	8056
2.	Authentication*	1233
3.	Visitors	5400
4.	Information provided	2569
5.	Training imparted	1004

\* fee charged for issue of certificate from 2019

-----

Role of herbarium in identification, and in solving problems relating to taxonomic delineation make it very significant in science in general and PGR in particular. NHCP at NBPGR visualizes many challenges and new initiatives- digitization of entire holdings, computerized data bases, linking with genebank, seedling studies for species delineation, and taxonomy of crop plants of India. To meet with these, the following points have been identified:

### **New Initiatives**

- Enrich material through vouchers generated during research programmes
- Enrichment of herbarium for primitive landraces, obsolete cultivars or elite types and wild types
- Enrichment through explorations from underexplored areas; species mainly CWRs
- Authentication/ validation of the holdings with physical verification of taxa.
- Taxonomic and biosystematic studies in Indian taxa using morphological and molecular tools
- QR codes on herbarium specimens for easy retrieval of data
- Video/ visual aids on teaching on plant taxonomy and PGR
- HRD: trainings with expert organizations globally taxonomists through MOU/ trainings abroad

### **Future Prospects**

- Prioritization: holdings in wild species related to crop plants and wild and potential important species.
- Studies: seed and seedling morphology of crop taxa to serve as a base line for identification.
- Computerization: herbarium and databasing of information for retrieval and identification of species/species variants along with digitized images.
- Modernization: use of electronic media; digital access for use of the herbarium; GIS enabled mapping of herbarium

- Audio visual aids: video, on-line series to popularize; teaching/ trainings, on social media
- New facilities: increase storage facilities to enhance the landrace diversity
- Research and development activities on native crop taxonomy and systematic; protocol for eco-friendly storage conditions
- Creating documentation through inventorization and information databank on crop taxa of India
- Identification services for strengthening identification service for other organizations
- NHCP Web page: with complete access of holdings
- Linkages: long-term vision is linking digital images with key national institutes-BSI, NBRI making online unified herbarium service like GBIF
- Data base linkage with the other facilities of NBPGR (conservation, PQD, evaluation).
- Recognition: designate NHCP as referral authority for taxonomic studies, nomenclature and issuance of authentication certificates for cultivated plants

-----

## Selected Readings/ References Cited

1. Ambasta SP, Ramachandran K, Kashyapa K, Chand R (eds) (1986) Useful plants of India. Publication and Information Directorate, Central Scientific and Industrial Research, New Delhi, India
2. Arora RK, Nayar ER (1983) An Assessment of threatened plants of India, In: S.K. Jain and R.R. Rao (eds.) Botanical Survey of India, Calcutta pp 287-292
3. Arora RK, Nayar ER (1984) Wild relatives of crop plants in India. NBPGR Monograph No. 7, National Bureau of Plant Genetic Resources, New Delhi, India, p 90
4. Arora RK, Pandey A (1996) Wild edible plants of India: Diversity, Conservation and use. National Bureau of Plant Genetic Resources, New Delhi, 294 p
5. Bhatt KC, Pandey A, Dhariwal OP, Panwar NS, Bhandari DC (2009a) 'Tum-thang' (*Crotalaria tetragona* Roxb. ex Andr.): a little known wild edible species in the northeastern hill region of India. Genet Resour Crop Evol 56:729-733
6. Bhatt KC, Sharma N, Pandey A (2009b) 'Ladakhi tea' *Bidens pilosa* L. (Asteraceae): A cultivated species in the cold desert of Ladakh Himalaya, India. Genet Resour Crop Evol 56:879-882
7. Davis PH, Heywood VH (1963) Principles in angiosperm taxonomy. University of Edinburgh Press. Great Britain. p. 556
8. Fuller TC, Barber GD (1981) A micro-wave oven method for drying succulent plant specimens. Taxon 30: 867
9. Holmgren PK, Holmgren NH (1998; updated). Index Herbariorum: A global directory of public herbaria and associated staff. New York: New York Botanical Garden
10. Jain SK, Rao RR (1977) Handbook of field and herbarium methods. Today and Tomorrow's Printers and Publishers, New Delhi
11. Lawrence GHS (1951) Taxonomy of flowering Plants. Oxford & IBH Publishing Co. p. 823
12. Malav PK, Pandey A, Bhatt, KC Krishnan SG, Bisht IS (2015) Morphological variability in holy basil (*Ocimum tenuiflorum* L.) from India. Genet Resour Crop Evol 62: 1245-1256
13. Nayar ER (2015) Crop wild relatives in Indian gene centre: An Overview. In: Pradheep K, Pandey A, Bhatt KC, Ahlawat SP, Semwal DP, Bansal KC (eds) Crop wild relatives: Identification, collecting and utilization, ICAR-NBPGR, New Delhi, pp 18-26
14. Nayar ER, Pandey A, Pradheep K, Gupta R, (2011) Inventory of digitized taxa in the NHCP. National Bureau of Plant Genetic Resources, New Delhi

15. Nayar ER, Pandey A, Pradheep K, Gupta R, Sharma SK (2014) National Herbarium of Cultivated Plants (NHCP): Importance of voucher specimens of introduced germplasm. *Ind J Plant Genet Resour* 27: 163-170
16. Nayar ER, Pandey A, Venkateswaran K, Gupta R, Dhillon BS (2003) Crop Plants India: A Check-list of Scientific Names. Agro-biodiversity (PGR)-26. National agricultural technology project on sustainable management of plant biodiversity, National Bureau of Plant Genetic Resources, New Delhi, 48p
17. Pandey A (2015a) Plant Systematics: Field inventory, herbarium preparation and management of important herbaria and botanical gardens of the world and India. Institute of Life Long Learning, Delhi University (<http://vle.du.ac.in/mod/resource/view.php?id=13116>) ISSN NO. 978-93-85611-90-2
18. Pandey A (2015b) Plant Systematics: Documentation: Flora, Monographs, Journals, Online Journals and Keys. Institute of Life Long Learning, Delhi University (<http://vle.du.ac.in/mod/resource/view.php?id=13116>) ISSN NO. 978-93-85611-90-2
19. Pandey A, Bhatt KC (2008) Diversity distribution and collection of genetic resources of cultivated and weedy type in *Perilla frutescens* var. *frutescens* and their utilization in Indian Himalaya. *Genet Resour Crop Evol* 55:883-892
20. Pandey A, DC Bhandari, KC Bhatt, SK Pareek, AK Tomar and BS Dhillon (2005) Wild Relatives of Crop Plants in India: Collection and Conservation. Agro-biodiversity (PGR) 41. National Agricultural technology project on sustainable management of plant biodiversity, National Bureau of Plant Genetic Resources, New Delhi, 73p
21. Pandey A, Joshi V, Lachungpa U (2011b) Notes on cultivation, variability and conservation of scarlet runner bean (*Phaseolus coccineus* L.): A fast disappearing minor pulse of India. *Ann For* 19(1):34-38
22. Pandey A, Malav PK, Rai KM, Ahlawat SP (2022) Genus *Allium* L. of the Indian Region: A field guide for germplasm collection and identification. ICAR-National Bureau of Plant Genetic Resources, New Delhi, India, 110p
23. Pandey A, Nayar ER (1994) Some observations on systematics of genus *Crotalaria*. *Ind J Plant Genet Resour* 7(2):133-144 (Spl. issue)
24. Pandey A, Nayar ER, Gupta R (2006a) An Efficient methodology for processing of herbarium specimens of cultivated plants. *Ind J Plant Genet Resour* 19:47-49
25. Pandey A, Nayar ER, Pradheep K Gupta R (2013a) Preparation of herbarium specimens of cultivated plants. In: Training Manual on Management of Plant Genetic Resources (eds. Jacob et al.), National Bureau of Plant Genetic Resources, New Delhi, India, pp 14-20
26. Pandey A, Nayar ER, Venkateswaran K (2007) Plant genetic resources of Rosaceae in India. National Bureau of Plant Genetic Resources, New Delhi, 53p



27. Pandey A, Negi KS, Pradheep K, Singh MC (2015b) Note on Occurrence of fragrant false garlic (*Nothoscordum gracile* (Aiton) Stearn) in India. *Ind J Plant Genet Resour* 28:351-355
28. Pandey A, Pandey R (2005) Wild useful species of *Allium* in India- key to identification. *Ind J Plant Genet Resour* 18(2):175-178
29. Pandey A, Pradheep K Sharma N (2014) Potential introduced medicinal plant African bitter leaf (*Vernonia amygdalina* Delile) in India: Botany, propagation and uses. *Med Pl* 6: 272-276
30. Pandey A, Pradheep K, Gupta R (2014c) Chinese chives (*Allium tuberosum* Rottler ex Sprengel): A Home garden species or a commercial crop in India. *Genet Resour Crop Evol* 61:1433-1440
31. Pandey A, Pradheep K, Gupta R (2015) Manual on National Herbarium of Cultivated Plants. National Bureau of Plant Genetic Resources, New Delhi, 50 p; i-vi
32. Pandey A, Pradheep K, Gupta R (2016a) Herbarium Procedures (guidelines for beginners) National Herbarium of Cultivated Plants. Division of Plant Exploration and Germplasm Collection, National Bureau of Plant Genetic Resources, New Delhi, 6p
33. Pandey A, Pradheep K, Gupta R (2016b) Methodology for collecting and preparing herbarium specimen of *Allium*. *Indian J Plant Genet. Resour.* 29: 32-39
34. Pandey A, Pradheep K, Gupta R Nayar ER, Bhandari DC (2011a) Drumstick tree (*Moringa oleifera* Lam.): A multipurpose potential species in India. *Genet Resour Crop Evol* 58(3):453-460
35. Pandey A, Pradheep K, Semwal DP (2014a) Notes on *Luffa* (Cucurbitaceae) Genetic resources in India: diversity distribution, germplasm collection, morphology and use. *Ind J Plant Genet Resour* 27: 47-53
36. Pandey A, Semwal DP, Bhatt KC, Gupta R, Ahlawat SP (2016) A new report on cultivation of “Sukhlai” [*Abelmoschus manihot* (L.) Medik. subsp. *tetraphyllus* (Roxb. ex Hornem.) Borss. Waalk.]: A species used as organic clearant in jaggery industry in India. *Genet Resour Crop Evol* 63(8):1447-1455
37. Pandey A, Singh R, Radhamani J Bhandari DC (2010) Exploring the potential of *Ziziphus nummularia* (Burm. f.) Wight et Arn. from drier regions of India. *Genet Resour Crop Evol* 57(6): 929-936
38. Pandey A, Tomer A, Bhandari DC, Pareek SK (2008) Towards collection of wild relatives of crop plants in India. *Genet Resour Crop Evol.*55:187-202
39. Pandey A, Singh R, Chaudhury R, Malik SK (2013) Systematic Studies on *Crotalaria tetragona* Roxb. ex Andr. (Fabaceae-Crotalarieae): A Wild relative of sunhemp. *Ind J P Genet Resour* 26(1): 68-75
40. Pandey Anjula (2019) Herbarium management: methods and current trends. Training Manual, ICAR-NBPGR, New Delhi, India, pp. 157

41. Pandey Anjula, K Pradheep, RK Pamarthi and SP Ahlawat (2020) The Guidelines for the NHCP Users. ICAR-National Bureau of Plant Genetic Resources, New Delhi, India, 8p + i-iii
42. Pandey A, Pamarthi RK, Pradheep K, Gupta R, Ahlawat SP (2021) Catalogue of the Type Specimens in the National Herbarium of Cultivated Plants. National Bureau of Plant Genetic Resources, New Delhi, 67p
43. Pandey Anjula, Kuldeep Tripathi, K Pradheep, S Rajkumar and Veena Gupta (2019) The Teaching Manual on Plant Taxonomy. ICAR-National Bureau of Plant Genetic Resources, New Delhi, India, 119p.
44. Pradheep K, DR Pani and KC Bhatt (2015) Taxonomic notes on the *Trichosanthes cucumerina* group (Cucurbitaceae) from India. *Novon* 24: 39-45
45. Pradheep K, Pandey A Bhandari DC (2011a) Notes on naturalized taxa of plant genetic resource value in Himachal Pradesh. *Ind J P Genet Resour* 24(3): 293-298
46. Pradheep K, Pandey A, Bhatt KC and Nayar ER (2014) *Herpetospermum operculatum* (Schizopeponeae, Cucurbitaceae): A new species from India, Myanmar and China. *Blumea* 59:1-5
47. Pradheep K, Pani DR, Bhandari DC (2013) Addition of *Gymnopetalum chinense* (Lour.) Merr. to the flora of Odisha. *Indian For* 139(5):465-466
48. Pradheep K, Rathi RS, Soyimchiten, Nayar ER (2015) “Meetha patta” (*Plukenetia corniculata* Sm.): A new report of leafy vegetable crop from north-eastern region of India. *Genet Resour Crop Evol* 62:1113-1120
49. Pradheep K, Singh, PK Pandey A, Bhandari DC (2011b) Collecting genetic resources of wild *Moringa oleifera* Lam. from western Himalayas. *Ind J Plant Genet Resour* 24(1): 75-81
50. Rao RR, Sharma BD (1990) A Manual for herbarium collections. Botanical Survey of India. p 20
51. Rathi RS, Pradheep K, Roy S, Singh SK, Misra AK (2016) *Stahlianthus involucratus* (King ex Baker) Craib ex Loes.: A new record to the flora of Mizoram, India. *J Threat Taxa* 8(3):8629-8631
52. Semwal DP, Bhatt KC, Bhandari DC, Panwar NS (2014) A note on distribution, ethnobotany and economic potential of *Hodgsonia heteroclita* (Roxb.) Hook.f. & Thoms. (Cucurbitaceae) in north-eastern India. *Ind J Nat Product Resour* 5:88-91
53. Singh HB (2010) Handbook on Herbaria in India and neighboring countries. National Institute of Science Communication and Information Resources (NISCAIR), New Delhi
54. Soyimchiten, Pradheep K, John KJ, Nayar ER (2015) An occurrence of Indo-Chinese taxon *Momordica subangulata* Blume subsp. *subangulata* (Cucurbitaceae) in Nagaland: A new distribution record from India. *J Threat Taxa* 7:8182-8184

# Annexures

## Annexure 1

### Year-wise Additions to the National Herbarium of Cultivated Plants (NHCP)

Year	Herbarium specimens	Seed samples	Economic products
~1989	7136	290	24
1989-1990	651	80	2
1990-1991	575	48	8
1991-1992	519	17	2
1992-1993	307	46	2
1993-1994	208	50	7
1994-1995	354	259	9
1995-1996	260	25	8
1996-1997	240	88	64
1997-1998	49	35	53
1998-1999	54	121	74
1999-2000	3030	165	53
2000-2001	797	436	30
2001-2002	665	69	20
2002-2003	384	81	18
2003-2004	831	191	47
2004-2005	1046	235	48
2005-2006	1176	114	18
2006-2007	687	153	14
2007-2008	575	229	26
2008-2009	313	90	37
2009-2010	325	70	10
2010-2011	296	20	12
2011-2012	289	34	35
2012-2013	302	62	19
2013-2014	287	30	14
2014-2015	404	7	8
2015-2016	378	22	10
2016-2017	428	12	14
2017-2018	592	11	10
2018-2019	612	6	32
2019-2020	460	46	11
2020-2021	353	9	6
2021-2022	700	30	11
<b>Total</b>	<b>25283</b>	<b>3181</b>	<b>756</b>

## Guidelines for availing services from the NHCP

The request for availing services from the NHCP may be made by an individual(s)/ or a group(s) of individual(s) from an institution(s) after submitting a “**mandatory form**” (Annexure 2.1). This communication can be made preferably through a letter or e-mail sent to the curator NHCP.[curator@icar.gov.in](mailto:curator@icar.gov.in)) mentioning about type of service desired, number of persons, intended purpose, tentative date and time (in case of visit/consultation/ training), and other related information(s). The detailed guidelines [“The Guidelines for the NHCP Users – NBPGR” is available on link: www.nbpgr.ernet.in › nhcp › publicationpdf › GuidelinesfortheNHCP.](http://www.nbpgr.ernet.in/nhcp/publicationpdf/GuidelinesfortheNHCP) The NHCP provides the following services to indentors. To avail the facility, a mandatory form, should be deposited and wait for the approval of the Curator, NHCP. For ready reference and access the same have been abdiged below:

### A. Consultation visit:

- On arrival at the NHCP, he should check for the intended taxa available in herbarium using digital catalogue and /or index cards.
- Consult digital herbarium for the intended taxa and request curator for relevant herbarium folder(s) maintained in the storage compactors.
- Locate the family folders alphabetically categorized/arranged and trace the species of interest.
- Indentor should ensure to handle the herbarium specimen(s) carefully and later material be handed curator after use. **Consultation of ‘Type’ specimen** is permitted only after prior permission from the curator, and is to be handled with utmost care. **‘Type’ specimen** consultation is **not permitted** to the general visitors.
- For clicking the photograph(s) or material of interest, the indenter may kindly deposit the proforma (Annexure 2).

### B. Specimen identification/authentication and/ or issuance of authentication certificate

- Indenter will deposit complete herbarium specimen along with copy of approval by NHCP, copy of the fee remittance (hard or soft), a letter of request issued from the parent/affiliating institute with detailed information on name of the indenter, date of specimen collection, type of material, source locality/ habitat, plant part used in study, proposed study (thrust area), etc. for which AC is desired.
- Deposit completely processed herbarium specimen (mounted on the board/ or place inside newspaper/blotters; delivery by post/by hand) along with flowers and/or fruits and/ or other identifiable parts (product, etc.).
- Incomplete sample(s) deposited as raw material/ plant products/or part of the material- leaf, bark, stem sample(s) are not acceptable for issuance of AC.

***Processing fee structure and method of payment***

- For issue of the **Authentication Certificate (AC)**, the indenter has to pay a sum of **Rs. 500/ - (Rs. Five hundred only) per specimen charged as processing fee from the students/researchers belonging to public and private institutions.** However, **Rs 500/- (Rs Five hundred only) and 1,000/- (Rs One thousand only)** are charged from public and private organizations, respectively.
- The copy of the receipt of payment made towards AC should be provided to the Curator, NHCP along with the herbarium specimen in order to process the same.
- In case of more than one specimen, the separate request is to be made.
- **How to pay fee:** on getting the approval from curator to deposit fee for issue of AC, the payment should be made online in the following account- **Account name: Director-NBPGR; Bank: The Canara Bank; Account type: Current A/C; Branch Name: NSC Beej Bhawan; Locality Postal Address: Canara Bank, Near NSC, Beej Bhawan, Pusa, New Delhi 110012; IFSC code CNRB0019121; MICR code: 110015429; Account No. 91213050000016. Clear narration “Fee for Authentication”** should be made to trace the credited amount. It can also be paid through credit/debit card and transaction details communicated via e-mail ([nbpgr.herbarium@icar.gov.in](mailto:nbpgr.herbarium@icar.gov.in); [nbpgr.exploration@icar.gov.in](mailto:nbpgr.exploration@icar.gov.in)).

- **Processing time** for issuance of AC is **15 days** (after depositing processing fee and herbarium specimen). Provide two e-mail accounts and contact number for dispatch of the AC and for further correspondence.

### **C. Visit to the NHCP**

- Date and arrival, time and duration of visit, details of the visitors (college/school; research organization, others-farmer, NGO, etc.) and number of team members should be clearly indicated to facilitate for necessary arrangements.
- The date and time of visit should be fixed only after the approval and confirmation made through enquiry (e-mail/ phone) from the Curator, NHCP.

### **D. Training/technical know-how on herbarium procedures**

- Training is imparted for technical know-how on basic herbarium procedures through visual media or demonstrations mainly for the school and college students.
- Deposit mandatory form (Annexure 1) requesting for tentative date/ time conveyed for arranging the trainings. The visit should be made only after approval by the curator, NHCP.
- The NHCP does not provided certificate for imparting any training/technical know-how on herbarium procedures and such events are need based.

### **E. Depositing voucher herbarium specimen(s)**

- A well prepared standard herbarium specimens representing all parts especially flowers, or fruits or both are accepted as “*Vouchers*” for deposition in the NHCP (refer link on web). Vouchers may be submitted here without mounting (use newspaper/blotter) and list of specimens along with all details.
- Specimens should be well-labeled with complete details on collection date, associated flora, locality and habitat features; field notes should be clearly recorded. Economic products such as fruits, dried flowers, fibres, gums, etc. may also be additionally provided.

- Characters of the plant which are lost on drying, or which may not be represented in the herbarium specimen (height of plant for trees or shrubs), flower colour, leaflets (which may be shed on drying) should be noted on the herbarium record sheet/label data.
- Fully dried specimens should be dispatched into bundles (of 30-35 specimens/bundle) in between thick sheets of cardboard and tied tightly prior to transportation. In the event of specimens not being completely dry (even after 3-4 changes), extra corrugated sheets may be placed between specimens till they are brought to the destination. The herbarium specimen may be labelled as ‘*Voucher Specimen*’; ‘*Fragile Material*’; ‘*Handled Carefully*’
- Fruits, seed samples and economic products, which may often be large and bulky, could be dried and sent separately.
- For preparation and deposition of herbarium samples of “*difficult-to-process*” type such as diversity in cultivars, large specimens: rhizomatous/tuberous/bulbous types; aquatic plants; fleshy material (stem/flowers, leaves) photo of the whole plant should accompany to aid identification.
- The ‘fragile’ material should preferably be brought personally (and not despatched through post/courier) to ensure proper handling. For dispatch through postage, label should be put as ‘fragile material’.

#### **F. Photography of the herbarium specimen(s)**

- For taking photographs or images of the herbarium specimens, the indenter should seek approval of the authorities/ curator by filling the proforma (Guidelines Pandey et al.).
- While photography, indenter should select and handle the herbarium specimen(s) with utmost care not to damage/spoil them
- The use of herbarium specimens’ images supplied by the NBPGR-NHCP are subject to the terms and conditions specified (Annexure2).

## List of new taxa described by ICAR-NBPGR and deposited (#) in Indian and other International herbaria

Sl. No.	Taxa**	Herbarium /collection id	Type	Acronym of deposited herbarium*
1	<i>Abelmoschus angulosus</i> Wight & Arn.var. <i>mahendragiriensis</i> R.C. Misra & D.Pani	HS22810	Holotype	NHCP
2	<i>Abelmoschus enbeepegearensis</i> K.J.John, Scariah, Nissar, K.V.Bhat & S.R.Yadav	HS21417	Holotype	NHCP
	<i>Abelmoschus enbeepegearensis</i> K.J.John, Scariah, Nissar, K.V.Bhat & S.R.Yadav	JRN/09-25	Isotype	CAL
	<i>Abelmoschus enbeepegearensis</i> K.J.John, Scariah, Nissar, K.V.Bhat & S.R.Yadav	JRN/09-25	Isotype	CALI
	<i>Abelmoschus enbeepegearensis</i> K.J.John, Scariah, Nissar, K.V.Bhat & S.R.Yadav	JRN/09-25	Isotype	MH
3	<i>Abelmoschus pungens</i> var. <i>mizoramensis</i> K.J. John, Krishnaraj & K.Pradeep	HS24043	Holotype	NHCP
	<i>Abelmoschus pungens</i> var. <i>mizoramensis</i> K.J. John, Krishnaraj & K.Pradeep	HS24044	Paratype	NHCP
	<i>Abelmoschus pungens</i> var. <i>mizoramensis</i> K.J. John, Krishnaraj & K.Pradeep	JJK/11-1	Isotype	CAL
5	<i>Abelmoschus tuberculatus</i> Pal & Har.B.Singh	HS5280	Holotype	NHCP
	<i>Abelmoschus tuberculatus</i> Pal & Har.B.Singh	HS5277	Isotype	NHCP
7	<i>Cucumis melo</i> subsp. <i>melo</i> var. <i>alwarensis</i> A. Pandey & S. Rajkumar	HS24385	Holotype	NHCP
	<i>Cucumis melo</i> subsp. <i>melo</i> var. <i>alwarensis</i> A. Pandey & S. Rajkumar	HS24583	Paratype	NHCP
8	<i>Curcuma amada</i> var. <i>glabra</i> Velay., Unnikr., Asha & Maya	HS17868	Holotype	NHCP
9	<i>Curcuma amada</i> var. <i>glabra</i> Velay., Unnikr., Asha & Maya	HS17445	Paratype	NHCP
10	<i>Curcuma karnatakensis</i> Amalraj, Velay. & Mural.	HS8286	Isotype	NHCP
	<i>Curcuma karnatakensis</i> Amalraj, Velay. & Mural.	Amalraj 807	Holotype	MH
11	<i>Curcuma kshnopatra</i> Velay.	HS15288	Holotype	NHCP
12	<i>Curcuma kudagensis</i> Velay., V.S. Pillai & Amalraj	V1561	Holotype	E
	<i>Curcuma kudagensis</i> Velay., V.S. Pillai & Amalraj	HS15291	Isotype	NHCP
13	<i>Curcuma longa</i> var. <i>vanaharidra</i> Velay., Pandrav., J.K. George & Varap.	HS18852	Holotype	NHCP
14	<i>Curcuma malabarica</i> Velay., Amalraj & Mural.	AV 158	Holotype	MH
	<i>Curcuma malabarica</i> Velay., Amalraj & Mural.	AV 158	Isotype	E
	<i>Curcuma malabarica</i> Velay., Amalraj & Mural.	HS7616	Isotype	NHCP



15	<i>Curcuma thalakaveriensis</i> Velay., Amalraj & Mural.	V3561	Holotype	MH
	<i>Curcuma thalakaveriensis</i> Velay., Amalraj & Mural.	HS8228	Isotype	NHCP
16	<i>Herpetospermum operculatum</i> K.Pradheep, A. Pandey, K.C. Bhatt & E.R. Nayar	1449	Holotype	CAL
	<i>Herpetospermum operculatum</i> K.Pradheep, A. Pandey, K.C. Bhatt & E.R. Nayar	1449	Isotype	DD
	<i>Herpetospermum operculatum</i> K.Pradheep, A.Pandey, K.C.Bhatt & E.R.Nayar	HS21356	Isotype	NHCP
17	<i>Momordica cochinchinensis</i> subsp. <i>cochinchinensis</i> (Lour.) Spreng	HS22675	Epitype	NHCP
18	<i>Momordica cochinchinensis</i> subsp. <i>andamanensis</i> Kattuk., Roy & Krishnaraj	HS22672	Isotype	NHCP
	<i>Momordica cochinchinensis</i> subsp. <i>andamanensis</i> Kattuk., Roy & Krishnaraj	HS22672	Paratype	NHCP
19	<i>Momordica sahyadrica</i> K.J. John & V.T. Antony	JJ 133	Holotype	CAL
	<i>Momordica sahyadrica</i> K.J. John & V.T. Antony	JJ 133	Isotype	MH
20	<i>Momordica subioica</i> Bharathi	HS20927	Holotype	NHCP
	<i>Momordica subioica</i> Bharathi	20927	Isotype	CAL
21	<i>Piper pseudonigrum</i> Velay. & Amalraj	AV202	Holotype	MH
	<i>Piper pseudonigrum</i> Velay. & Amalraj	HSAV202	Isotype	NHCP
22	<i>Trichosanthes dunniana</i> subsp. <i>Clarkei</i> K.Pradheep, KJ John, PK. Singh, R.S. Rathi & A Pandey	HS24213	Isotype	NHCP
	<i>Trichosanthes dunniana</i> subsp. <i>Clarkei</i> K.Pradheep, KJ John, PK. Singh, R.S. Rathi & A Pandey	2741	Isotype	DD
	<i>Trichosanthes dunniana</i> subsp. <i>Clarkei</i> K.Pradheep, KJ John, PK. Singh, R.S. Rathi & A Pandey	2741	Isotype	CAL
23	<i>Vigna konkanensis</i> Latha, K.V.Bhat, I.S.Bisht, Scariah, K.J.John & Krishnaraj	HS21377	Holotype	NHCP
	<i>Vigna konkanensis</i> Latha, K.V.Bhat, I.S.Bisht, Scariah, K.J.John & Krishnaraj	BB 64-2000	Isotype	TBGT
	<i>Vigna konkanensis</i> Latha, K.V.Bhat, I.S.Bisht, Scariah, K.J.John & Krishnaraj	BB 64-2000	Isotype	MH
	<i>Vigna konkanensis</i> Latha, K.V.Bhat, I.S.Bisht, Scariah, K.J.John & Krishnaraj	BB 64-2000	Isotype	CALI
	<i>Vigna konkanensis</i> Latha, K.V.Bhat, I.S.Bisht, Scariah, K.J.John & Krishnaraj	BB 64-2000	Isotype	CAL

\*-Acronym mentioned below

**CAL**-Central National Herbarium, BSI, Kolkata, West Bengal, India

**CALI**- Herbarium, University of Calicut, Kerala, India

**DD**-Forest Research Institute, Dehradun, India

**E**- Royal botanic garden, Edinburgh, Scotland, United Kingdom

**MH**- Herbarium, Southern Regional Centre, BSI, Coimbatore, Tamilnadu, India

**NHCP**- National Herbarium of Cultivated Plants, ICAR-NBPGR, New Delhi, India and

**TBGT**- Jawaharlal Nehru Tropical Botanic Garden and Research Institute, Trivandrum, Kerala, India

**#**: Abridge from Pandey et al, 2021 (Pandey Anjula, RK Pamarthi, K Pradheep, Rita Gupta and SP Ahlawat (2021) Catalogue of the Type Specimens in the National Herbarium of Cultivated Plants. ICAR-National Bureau of Plant Genetic Resources, New Delhi, India, 67p + i-iii)

List of families (arranged in alphabetic order),

Sr. No.	Family	Genus	Species
1.	Acanthaceae	45	125
2.	Aceraceae	1	12
3.	Actinidiaceae	2	4
4.	Aesculsceae	1	1
5.	Agavaceae	5	15
6.	Aizoaceae	7	12
7.	Alangiaceae	1	3
8.	Alismataceae	4	8
9.	Alliaceae	2	53
10.	Altingiaceae	1	1
11.	Amaranthaceae	20	62
12.	Amaryllidaceae	4	9
13.	Anacardiaceae	12	30
14.	Ancistrocladaceae	1	1
15.	Annonaceae	11	18
16.	Apiaceae	38	64
17.	Apocynaceae	23	41
18.	Aponogetonaceae	1	2
19.	Aquifoliaceae	1	6
20.	Araceae	23	39
21.	Araliaceae	7	7
22.	Araucariaceae	2	2
23.	Arecaceae	7	9
24.	Aristolochiaceae	3	7
25.	Asclepiadaceae	27	39
26.	Asparagaceae	4	4
27.	Aspidiaceae	5	10
28.	Aspleniaceae	2	4
29.	Asteraceae	130	281
30.	Athyriaceae	2	6
31.	Avicenniaceae	1	3
32.	Azollaceae	1	1
33.	Balanitaceae	2	3
34.	Balanophoraceae	1	1
35.	Balsaminaceae	2	7
36.	Barringtoniaceae	2	2
37.	Basellaceae	1	1
38.	Begoniaceae	1	4
39.	Berberidaceae	3	17
40.	Betulaceae	3	5
41.	Bignoniaceae	19	29
42.	Bixaceae	1	1
43.	Boraginaceae	20	38
44.	Bombacaceae	6	6
45.	Brassicaceae	39	80
46.	Bromeliaceae	2	1
47.	Buddlejaceae	1	6
48.	Burseraceae	5	6
49.	Butomaceae	1	1
50.	Buxaceae	2	7
51.	Cactaceae	2	2
52.	Caesalpiniaceae	19	59
53.	Calophyllaceae	3	3
54.	Calycanthaceae	1	1
55.	Campanulaceae	7	13
56.	Cannabinaceae	2	3
57.	Cannaceae	1	2
58.	Capparidaceae	15	29
59.	Caprifoliaceae	7	28
60.	Caricaceae	1	2
61.	Carpinaceae	2	2
62.	Caryophyllaceae	17	40
63.	Casuarinaceae	1	4
64.	Celastraceae	5	9
65.	Cercidophyllaceae	1	1
66.	Chenopodiaceae	15	46
67.	Cistaceae	1	1
68.	Clusiaceae	4	12
69.	Cochlospermaceae	1	1
70.	Combretaceae	10	18
71.	Commelinaceae	10	17

72.	Connaraceae	1	1
73.	Convolvulaceae	14	49
74.	Coriariaceae	1	2
75.	Cornaceae	3	8
76.	Corynocarpaceae	1	1
77.	Costaceae	1	1
78.	Crassulaceae	3	9
79.	Cucurbitaceae	39	128
80.	Cunoniaceae	2	2
81.	Cupressaceae	5	10
82.	Cuscutaceae	1	1
83.	Cycadaceae	1	1
84.	Cyperaceae	14	96
85.	Daphniphyllaceae	1	1
86.	Datisceae	1	1
87.	Davidiaceae	1	1
88.	Dennstaedtiaceae	1	1
89.	Dichapetalaceae	1	1
90.	Dilleniaceae	3	6
91.	Dioscoreaceae	1	20
92.	Dipsacaceae	3	4
93.	Dipterocarpaceae	4	4
94.	Dryopteridaceae	1	1
95.	Ebenaceae	1	14
96.	Ehretiaceae	2	6
97.	Elaeagnaceae	2	8
98.	Elaeocarpaceae	1	6
99.	Elatinaceae	1	1
100.	Epacridaceae	3	4
101.	Ephedraceae	1	4
102.	Equisetaceae	1	5
103.	Ericaceae	8	23
104.	Eriocaulaceae	1	3
105.	Euphorbiaceae	51	113
106.	Fabaceae	134	552
107.	Fagaceae	4	13
108.	Flacourtiaceae	4	10
109.	Frankeniaceae	2	2
110.	Fumariaceae	2	5
111.	Gentianaceae	9	27

112.	Geraniaceae	3	11
113.	Gesneriaceae	2	2
114.	Ginkgoaceae	2	1
115.	Gnetaceae	2	4
116.	Goodeniaceae	3	3
117.	Grossulariaceae	1	9
118.	Hamamelidaceae	4	4
119.	Heliconiaceae	1	1
120.	Hippocastanaceae	1	1
121.	Hippocrateaceae	1	1
122.	Hydrangeaceae	2	3
123.	Hydrocharitaceae	7	7
124.	Hymenophyllaceae	1	1
125.	Hypericaceae	1	11
126.	Hypoxidaceae	1	1
127.	Icacinaceae	1	1
128.	Iridaceae	4	10
129.	Juglandaceae	3	6
130.	Juncaceae	2	6
131.	Lamiaceae	58	142
132.	Lardizabalaceae	1	1
133.	Lauraceae	10	35
134.	Lecythidaceae	2	2
135.	Leeaceae	1	1
136.	Lentibulariaceae	1	2
137.	Liliaceae	27	44
138.	Limnocharitaceae	3	5
139.	Linaceae	2	11
140.	Loganiaceae	1	1
141.	Loranthaceae	6	8
142.	Lycopodiaceae	1	4
143.	Lythraceae	8	16
144.	Magnoliaceae	3	7
145.	Malpighiaceae	5	7
146.	Malvaceae	27	90
147.	Marantaceae	4	4
148.	Marsileaceae	1	2
149.	Martyniaceae	2	2
150.	Melastomataceae	5	10
151.	Meliaceae	12	14




152.	Menispermaceae	8	17	192.	Plantaginaceae	7	30
153.	Mimosaceae	18	53	193.	Platanaceae	1	1
154.	Molluginaceae	3	7	194.	Plumbaginaceae	2	6
155.	Moraceae	7	68	195.	Poaceae	182	638
156.	Morinaceae	1	1	196.	Podocarpaceae	2	4
157.	Moringaceae	1	2	197.	Podophyllaceae	1	2
158.	Muntingiaceae	1	1	198.	Polemoniaceae	2	3
159.	Musaceae	2	5	199.	Polygalaceae	2	5
160.	Myricaceae	2	7	200.	Polygonaceae	12	61
161.	Myristicaceae	2	7	201.	Polypodiaceae	5	4
162.	Myrsinaceae	5	11	202.	Pontederiaceae	2	2
163.	Myrtaceae	16	52	203.	Portulacaceae	3	6
164.	Najadaceae	2	3	204.	Potamogetonaceae	1	4
165.	Nothofagaceae	1	2	205.	Primulaceae	5	18
166.	Nyctaginaceae	6	9	206.	Proteaceae	4	11
167.	Nymphaeaceae	3	3	207.	Pteridaceae	2	5
168.	Nyssaceae	1	1	208.	Punicaceae	1	1
169.	Ochnaceae	1	1	209.	Ranunculaceae	13	56
170.	Olacaceae	2	2	210.	Resedaceae	1	1
171.	Oleaceae	10	40	211.	Restionaceae	2	2
172.	Oleandraceae	1	1	212.	Rhamnaceae	7	28
173.	Onagraceae	5	17	213.	Rhizophoraceae	4	6
174.	Onychiaceae	1	1	214.	Roccellaceae	1	1
175.	Ophioglossaceae	2	2	215.	Rosaceae	38	209
176.	Orchidaceae	31	41	216.	Rubiaceae	53	81
177.	Orobanchaceae	4	6	217.	Rutaceae	21	45
178.	Osmundaceae	1	2	218.	Sabiaceae	1	1
179.	Oxalidaceae	4	15	219.	Salicaceae	6	19
180.	Palmae	2	2	220.	Salvadoraceae	1	2
181.	Pandanaceae	1	2	221.	Samydaceae	1	2
182.	Papaveraceae	8	21	222.	Santalaceae	2	3
183.	Parmeliaceae	1	1	223.	Sapindaceae	16	24
184.	Passifloraceae	2	11	224.	Sapotaceae	9	13
185.	Pedaliaceae	4	14	225.	Saururaceae	4	2
186.	Philadelphaceae	1	1	226.	Saxifragaceae	9	16
187.	Philydraceae	1	1	227.	Schizaeaceae	1	1
188.	Phytolaccaceae	1	3	228.	Schizandraceae	1	1
189.	Pinaceae	9	14	229.	Scrophulariaceae	28	57
190.	Piperaceae	2	42	230.	Simaroubaceae	4	5
191.	Pittosporaceae	3	3	231.	Simmondsiaceae	1	1

232.	Simplocaceae	2	1
233.	Smilacaceae	1	7
234.	Solanaceae	20	119
235.	Sonneratiaceae	1	2
236.	Sphenocleaceae	2	1
237.	Staphyleaceae	1	3
238.	Stemonaceae	1	1
239.	Sterculiaceae	17	24
240.	Strychnaceae	1	2
241.	Symphoremataceae	1	2
242.	Symplocaceae	1	5
243.	Taccaceae	1	1
244.	Tamaricaceae	2	3
245.	Taxaceae	2	3
246.	Taxodiaceae	2	2
247.	Theaceae	8	12
248.	Thelypteridaceae	3	4
249.	Thunbergiaceae	1	6

250.	Thymelaeaceae	7	13
251.	Tiliaceae	8	44
252.	Trapaceae	1	4
253.	Trilliaceae	2	3
254.	Tropaeolaceae	1	2
255.	Turneraceae	1	1
256.	Ulmaceae	6	6
257.	Urticaceae	16	28
258.	Valerianaceae	3	8
259.	Verbenaceae	20	64
260.	Violaceae	2	11
261.	Viscaceae	1	1
262.	Vitaceae	7	37
263.	Vitidaceae	2	2
264.	Xanthorrhoeaceae	1	1
265.	Zamiaceae	1	1
266.	Zingiberaceae	14	73
267.	Zygophyllaceae	5	8

← → ↻ Not secure | nbpgr.ernet.in:8080/nhcp/

QR Code for Text | SBI Securities | Online Share Tradin... | Student Dashboard... | 90s Hit Hindi Bolly... | ICAR-Indian Agricul... | Android JSON Parsi... | CRUD Operation in... | Outlook Web App


  

# National Herbarium of Cultivated Plants

HOME ABOUT SEARCH CONTACT


One Step Ahead to Herbarium

Herbarium Data : 1380



ICAR-NBPGR

Guideline Circular Useful links Admin

Visitors: 4442  
Download Mobile App 

Developed in ICAR National Fellow Project  
Copyright (©)2017-18 All right Reserved National Bureau of Plant Genetic Resources  
New Delhi-110012, INDIA

Division of Plant Exploration and Germplasm Collection  
ICAR - National Bureau of Plant Genetic Resources  
Pusa Campus, New Delhi 110012, India  
<http://www.nbpgr.ernet.in/>