GLOBAL CROP CONSERVATION AND USE METRICS

OKRA
(*Abelmoschus* Medik.)

CROP TRUST

Cover photo: iStockphotot

Crop Trust
Platz der Vereinten Nationen 7
53113 Bonn, Germany

General Contact
+49 (0) 228 85427 118
info@croptrust.org

Suggested Citation
Khoury CK, Gora, S and Giovannini, P (2025) Global crop conservation and use metrics: Okra (*Abelmoschus* Medik.). Bonn, Germany: Global Crop Diversity Trust.

Funding Source
The development of this document was funded by the German Federal Ministry of Agriculture, Food and Regional Identity (BMLEH) as part of the project Mainstreaming Global Crop Conservation Strategies in Plant Treaty Processes led by the Crop Trust.

Global crop conservation and use metrics

OKRA
(*Abelmoschus* Medik.)

With support from

CROP TRUST

International Treaty on Plant Genetic Resources for Food and Agriculture

Federal Ministry of Agriculture, Food and Regional Identity

Description

This report provides an up-to-date overview of the global status of *ex situ* conservation of genetic resources of okra and its wild relatives, including key metrics on:

- global statistics on crop production, trade, and availability in food supplies;
- the identity and composition of genebank collections;
- the Multilateral System (MLS) status of accessions in these collections;
- storage, regeneration, and safety duplication status;
- documentation, information systems, and research resources;
- germplasm distribution;
- varietal registrations and releases; and
- crop networks and partnerships

Introduction and background on okra

Okra (*Abelmoschus esculentus* L. Moench) originated in either tropical Africa or South Asia, though Africa is most commonly cited (Kyriakopoulou *et al.*, 2014). The plant spread globally through trade routes, becoming established in the Americas during the trans-atlantic slave trade. Okra is now grown in tropical, subtropical, and warm temperate regions throughout the world (Suma *et al.*, 2023). It is cultivated primarily for its edible green seed pods, which are consumed as a vegetable in diverse cuisines worldwide, including in West African, Middle Eastern, South Asian, and Caribbean cooking, and can be prepared in a variety of ways, including frying, boiling, stewing, and pickling. The pods contain a mucilaginous substance that serves as a natural thickening agent, making okra central to dishes such as gumbo. The leaves, buds, and flowers are also consumed, especially in West Africa, and the fibers are used for paper and fuel (Suma *et al.*, 2023). Okra is of nutritional importance as a rich source of vitamins A and C, beta carotene, zinc, folic acid, and fiber, while its heat and drought tolerance make it an important crop for food security in regions where other vegetables struggle (Sandeep *et al.*, 2022).

Based on the most recently available production statistics from FAOSTAT, reporting for the year 2023, okra is cultivated in at least 54 countries on almost three million hectares worldwide, producing 11.5 million tonnes at a value of USD 9.6 billion (FAO, 2025a). The largest producers include India, Nigeria, Mali, Sudan, Pakistan, Egypt, Côte d'Ivoire, and Benin, each producing over 100,000 tonnes per annum. There is limited recorded international trade in okra (around 15,000 tonnes exported, and 56,000 tonnes imported, per annum), with Kenya being the largest reported exporter (FAO, 2025a). The top importers include the USA, Qatar, and Algeria. Global consumption statistics are imprecise, with FAOSTAT reporting okra under its "Vegetables, Other" category (Khoury *et al.*, 2023). Food supply contribution estimates are provided in Table 1.

Table 1. Global status of okra production, availability in food supplies, and public interest. Production and food supply statistics from FAOSTAT (2015 to 2018 average); trade data was not available for okra for this time period. Production metrics are reported directly for okra in FAOSTAT; for food supply, okra is placed within "Vegetables, Other" and the estimates presented here were derived by disaggregating that generalized food supply statistic using a weighted average based on crop production statistics (Khoury *et al.*, 2023). Number of countries refers to the count of countries where the crop is reported as within the top 95 percent of crops in terms of contribution to production or food supply. The evenness metric quantifies evenness of production or availability in food supplies across world regions, where 0 equals highly uneven and 1 equals completely even. The international interdependence metric quantifies the degree of production or availability in food supplies outside of the primary region of diversity of the crop, where 0 equals low estimated international interdependence and 1 equals high estimated international interdependence. Wikipedia metric is public pageviews over one year (2019) of the taxon name of the crop. All values from Khoury *et al.* (2023).

Metric	Global value	Number of countries where significant contributor	Evenness of contribution across world regions	Estimated international interdependence
Harvested area (ha)	2,345,716	9.75	0.08	0.78
Total production (tonnes)	9,199,888	12.25	0.10	0.35
Gross production value (current thousand USD)	7,460,464	15.50	0.08	0.23
Contribution to calories in food supplies (kcal/capita/day)	0.55	0.00	0.65	1.00
Contribution to protein in food supplies (g/capita/day)	0.03	0.00	0.63	1.00
Contribution to fat in food supplies (g/capita/day)	0.00	0.00	0.63	1.00
Contribution to food weight in food supplies (g/capita/day)	0.79	6.50	0.63	1.00
Number of public pageviews on Wikipedia over one year	4,679			

Identity and composition of *ex situ* collections

Based on the latest data in global genetic resource databases, germplasm collections of okra and its wild relatives (i.e., genus *Abelmoschus* Medik.) are present in at least 106 institutions worldwide, collectively maintaining 16,946 accessions (Table 2, Table 3; Supplementary Table 1). This is considerably more than the number of accessions reported for the crop (14,028) in the major germplasm collections listed in *The Third Report on the State of the World's Plant Genetic Resources for Food and Agriculture* (FAO, 2025b). The institutions are mainly distributed in Africa and Asia. The World Vegetable Center maintains an international collection for the crop (with 15.2% of total accessions worldwide), while the largest national are in India (21.1% of total), USA (17.6%), and Benin (9.6%), as well as Ghana, Sudan, and Türkiye; these international and national collections collectively maintain over three-quarters of documented accessions worldwide.

The International Board for Plant Genetic Resources (IBPGR)/International Plant Genetic Resources Institute (IPGRI) Register of Base Collections, which included collections that had formed (or had been proposed for) agreements with the international institutions based on long-term conservation of crop genepools on global or regional bases during the 1970s through 1990s (IBPGR/IPGRI, 1993; Thormann *et al.*, 2019), listed, for okra:

- National Bureau of Plant Genetic Resources (NBPGR) (India) – global collection (agreement dated 1987)
- USDA National Plant Germplasm System (NPGS) (USA) – global collection (proposed)

Based on the number of current accessions (Table 2), it appears that these recognized collections continue to maintain diverse okra germplasm.

Abelmoschus Medik. (Malvaceae) contains around 15 species, native to tropical Africa and to South, Southeast, and East Asia (USDA, 2025; WFO, 2025). A published genepool concept is available for okra [*Abelmoschus esculentus* (L.) Moench] (USDA, 2025). In this concept, progenitors include *A. esculentus* and *Abelmoschus tuberculatus* Pal & Singh. No species are currently assigned to primary or secondary genepools.

The tertiary genepool contains:
Abelmoschus angulosus Wall. ex Wight & Arn.
Abelmoschus caillei (A. Chev.) Stevels
Abelmoschus crinitus Wall.
Abelmoschus enbeepeegearensis K. J. John et al.
Abelmoschus ficulneus (L.) Wight & Arn.
Abelmoschus manihot (L.) Medik. (and subspecies)
Abelmoschus moschatus Medik. (and subspecies)
Abelmoschus tuberculatus Pal & Singh

Data compilation for this report on okra genetic resources included all taxa in *Abelmoschus*. Along with the crop, 11 taxa as well as a few hybrid accessions and many accessions only determined to the genus level are present in germplasm collections (Supplementary Table 2).

Landraces make up the largest proportion of collections (44.2%), although the data is approximate as 33.2% of accessions do not have biological status data and another 17.5% are marked as "other" materials. *Abelmoschus* germplasm has been collected from at least 95 countries, with approximately 42.3% of accessions originating from the primary region of diversity of the crop (i.e. East and West Africa and South and Southeast Asia); these statistics are also estimates, as 3.2% of okra landrace accessions and 1.7% of wild relative accessions do not contain information even of the country where the accession was collected. Information on botanic garden collections from BGCI PlantSearch indicate that 91 botanic gardens collectively conserve 10 *Abelmoschus* taxa. All of these taxa are also conserved in genebank collections.

Multilateral System status of accessions in *ex situ* collections

The genus *Abelmoschus* is not listed in Annex I of the International Treaty on Plant Genetic Resources for Food and Agriculture (Plant Treaty) and is thus not included in its Multilateral System of Access and Benefit Sharing (MLS). This said, genebanks can voluntarily place their collections under the MLS. Of the 16,946 accessions conserved globally, approximately 13% are held in international institutions (i.e., mainly the World Vegetable Center), and are included in the MLS of the Plant Treaty, with the remainder maintained in national and subnational collections (Table 4).

As of 2025, 4,067 accessions are formally included in the MLS according to the Plant Treaty's GLIS database, and 5,572 accessions have been assigned Digital Object Identifiers (DOIs). Per the relevant fields in the global genetic resources databases, 2,975 accessions (17.6% of world total) are listed as included in the MLS; this is likely an underestimate, noting that 73.2% of accessions do not have MLS status data. Among twelve non-Annex 1 crops analyzed in reports equivalent to this one, okra has among the highest proportion of accessions recorded as included in the MLS.

Table 2. Major *ex situ* collections of okra genetic resources. Top 20 institutions listed in descending order by total number of accessions. Number of accessions and storage condition information from Genesys and FAO WIEWS (2025), with supplementary information as noted. Multilateral System (MLS) status from Plant Treaty GLIS (2025) and from Genesys and FAO WIEWS (2025).

Institution Code	Institution name	Number of accessions	Percent of total	Cumulative percent	Number of accessions in long term storage (-18-20 C)	Number of accessions included in MLS (from Plant Treaty GLIS)	Number of accessions included in MLS (from genebank collections databases)
IND001	National Bureau of Plant Genetic Resources	3,581	21.1%	21.1%	3,578	0	0
USA016	Plant Genetic Resources Conservation Unit, Southern Regional Plant Introduction Station, University of Georgia, USDA-ARS	2,990	17.6%	38.8%	Not listed*	0	0
TWN001	World Vegetable Center	2,567	15.2%	53.9%	2,059	1,724	2,151
BEN097	Unité de Génétique, Biotechnologie et Science des Semences	1,625	9.6%	63.5%	Not listed	1,624	0
GHA091	Plant Genetic Resources Research Institute	822	4.8%	68.4%	Not listed	27	28
SDN002	Agricultural Plant Genetic Resources Conservation and Research Centre	683	4.0%	72.4%	683	0	0
TUR001	Plant Genetic Resources Department	626	3.7%	76.1%	626	0	0
NGA010	National Centre for Genetic Resources and Biotechnology	423	2.5%	78.6%	423	422	422
UZB006	Uzbek Research Institute of Plant Industry	341	2.0%	80.6%	Not listed	0	0
ZMB048	National Plant Genetic Resources Centre	235	1.4%	82.0%	235	138	0
BRA003	Embrapa Recursos Genéticos e Biotecnologia	199	1.2%	83.2%	Not listed	0	0
EGY087	National Gene Bank	173	1.0%	84.2%	Not listed	0	0
NGA003	National Horticultural Research Institute	165	1.0%	85.2%	Not listed	0	0
PAK001	Plant Genetic Resources Program	158	0.9%	86.1%	90	0	117
JPN183	NARO Genebank	157	0.9%	87.0%	50	0	0
LKA036	Plant Genetic Resources Centre	147	0.9%	87.9%	Not listed	0	0
BGD003	Bangladesh Agricultural Research Institute	144	0.8%	88.7%	127	0	15
USA974	Seed Savers Exchange	136	0.8%	89.5%	Not listed	0	0
BGD206	Lal Teer Seed Limited	131	0.8%	90.3%	131	0	0
JOR105	National Agricultural Research Center	126	0.7%	91.0%	Not listed	0	0
	Other institutions (n = 86)	1,517	9.0%	100.0%	627	132	242

* but known to conserve accessions in long-term storage conditions

Table 3. Composition of *ex situ* collections of okra genetic resources. Main *ex situ* collections data from Genesys and FAO WIEWS (2025). Primary and secondary regions information from Khoury *et al.* (2023) and subsequent research for this summary. Botanic gardens data from BGCI PlantSearch (2025).

Metric	Number	Percentage
Total number of accessions in genebank collections	16,946	
Number of institutions holding genebank collections	106	
Number of distinct taxonomic names in genebank collections	14	
Number of accessions of crop wild relatives (CWR) in genebank collections	290	1.7%
Number of accessions of weedy materials in genebank collections	10	0.1%
Number of accessions of landraces in genebank collections	7,495	44.2%
Number of accessions of breeding materials in genebank collections	278	1.6%
Number of accessions of improved varieties in genebank collections	284	1.7%
Number of accessions of other materials in genebank collections	2,969	17.5%
Number of accessions not marked with an improvement type in genebank collections	5,620	33.2%
Number of countries where germplasm has been collected for genebank collections	95	
Number of accessions in genebank collections from the primary region(s) of diversity	7,170	42.3%
Number of taxa in botanic garden collections	10	
Number of botanic gardens holding collections of crop or its wild relatives	91	

Table 4. Representation of okra accessions in international and national institutions, number of accessions with DOIs, and representation of accessions in the Multilateral System of Access and Benefit Sharing of the International Treaty on Plant Genetic Resources for Food and Agriculture. Main *ex situ* collections data from Genesys and FAO WIEWS (2025). DOI and MLS data from Plant Treaty GLIS (2025).

Metric	Number	Percentage
Number of accessions in genebank collections in international institutions	2,761	16.3%
Number of accessions in genebank collections in national or other institutions	14,185	83.7%
Number of accessions in genebank collections in Annex I	0	0%
Number of accessions with DOI (Plant Treaty GLIS 2025)	5,572	
Number of accessions included in the Multilateral System (MLS) (Plant Treaty GLIS 2025)	4,067	
Number of accessions included in the Multilateral System (MLS) (genebank collections databases)	2,975	17.6%
Number of accessions included in the Multilateral System (MLS) that are in international collections (genebank collections databases)	2,194	12.9%
Number of accessions not included in the Multilateral System (MLS) (genebank collections databases)	1,569	9.3%
Number of accessions without information regarding inclusion in the Multilateral System (MLS) (genebank collections databases)	12,402	73.2%

Storage conditions, regeneration status, and safety duplication

As expected for an orthodox seed crop, the great majority (at least 88.3%) of *Abelmoschus* accessions are conserved as seed, with 57.7% of these accessions listed as conserved under long-term cold-storage conditions (Table 5). Information on storage in general is missing for 11.2% of all accessions, and information on seed storage type (i.e., long, medium, or short term) is missing for 23% of seed accessions.

Current regeneration status and needs cannot be directly derived from the global germplasm databases. FAO WIEWS reporting for the *Third State of the World's Plant Genetic Resources for Food and Agriculture* (FAO, 2025b) for the years 2014 to 2019, documented 998 *Abelmoschus* accessions regenerated during this time by reporting institutions, with 1,161 accessions identified as needing regeneration and 894 of these lacking funds to conduct the regeneration.

Analysis of the location of safety duplication sites of okra germplasm, as listed in Genesys, indicates that at least 12.2% of accessions are safety duplicated in an active collection (i.e., apart from potentially being duplicated at the Svalbard Global Seed Vault [SGSV]) outside of the country of the main collection (Table 5).

The actual extent of safety duplication of okra accessions worldwide, when also considering safety duplication within the same country, may be higher than this estimate, given that some national genebanks, such as the USA, typically provide safety backup of their collections in a different location within the country. Information from the SGSV database from 2025 indicates that approximately 16.8% of total accessions worldwide are duplicated in Svalbard.

Table 5. Storage conditions of okra *ex situ* collections, regeneration status, and safety duplication status. Main *ex situ* collections data from Genesys and FAO WIEWS (2025). Regeneration status information from FAO WIEWS (2025); data from 2014 to 2019. Safety duplication out of the country data based only on Genesys (2025) data. Svalbard Global Seed Vault data from SGSV portal (2025).

Metric	Number	Percentage
Number of accessions held in seed storage in genebank collections	14,957	88.3%
Number of accessions held in short-term seed storage in genebank collections	44	0.3%
Number of accessions held in medium-term seed storage in genebank collections	2,839	19.0%
Number of accessions held in long-term seed storage in genebank collections	8,629	57.7%
Number of accessions held in seed storage of undefined type in genebank collections	3,445	23.0%
Number of accessions held in field storage in genebank collections	67	0.4%
Number of accessions held in *in vitro* storage in genebank collections	16	0.1%
Number of accessions held in cryo storage in genebank collections	3	0.0%
Number of accessions held as DNA in genebank collections	1	0.0%
Number of accessions held in other storage in genebank collections	0	0.0%
Number of accessions not marked with a storage type in genebank collections	1,903	11.2%
Number of accessions in genebank collections regenerated 2014–2019	9,987	48.5%
Number of accessions in genebank collections in need of regeneration 2014–2019	1,161	56.4%
Number of accessions in genebank collections in need of regeneration without budget for regeneration 2014–2019	894	43.4%
Number of accessions safety duplicated out of the country in genebank collections	1,192	12.2%
Number of accessions in genebank collections safety duplicated in Svalbard	2,838	16.8%

Documentation, information systems, and research resources

The World Vegetable Center published a descriptor list for okra in 2021 (WorldVeg, 2021). The estimated completeness of passport information for okra accessions listed in Genesys is 5.6 on a scale of 0 (no data) to 10 (complete data), which indicates that there are significant gaps that it would be valuable to fill. At least two okra characterization and evaluation datasets are available via Genesys, covering a total of 2,221 accessions. Four metrics of the current degree of digital sequence information (DSI) for okra (from the National Center for Biotechnology Information USA database), two metrics of published literature on the crop (Google Scholar and PubMed Central), and one metric of the degree of research resources such as herbarium specimens (from the Global Biodiversity Information Facility - GBIF), are listed in Table 6.

Okra stands out compared to many other vegetables in terms of the degree of research resources in GBIF (Khoury *et al.*, 2023).

Table 6. Documentation, information systems, and research resources for okra. Passport data completeness index (PDCI) from Genesys (2025), based on the methods outlined in van Hintum *et al.* (2011). Global Biodiversity Information Facility data from GBIF (2025). All other metrics data from Khoury *et al.* (2023).

Metric	Number
Passport data completeness index (range 0-10) as a median value across accessions in genebank collections	5.6
Number of genes as recorded in NCBI's Entrez database as of 2022	216
Number of genomes as recorded in NCBI's Entrez database as of 2022	0
Number of nucleotides as recorded in NCBI's Entrez database as of 2022	1,170
Number of proteins as recorded in NCBI's Entrez database as of 2022	7,124
Number of publications listed in Google Scholar with taxon name in title published between 2009 and 2019	2,610
Number of publications listed in PubMed Central with taxon name in text as of 2022	1,997
Number of research materials as recorded in GBIF (2025)	29,184

Germplasm distributions and varietal registrations and releases

Germplasm distributions and varietal development statistics for okra are listed in Table 7. Germplasm distribution data from FAO WIEWS and the Plant Treaty Data Store reflect different reporting scopes: FAO WIEWS primarily reports distributions from national genebanks, while the Plant Treaty Data Store includes all transfers made under the SMTA, encompassing distributions made by genebanks as well as by breeding programs and other organizational types (Khoury *et al.*, 2025). Distributions as reported in the FAO WIEWS dataset were made from institutions in 14 countries, with the largest numbers of samples distributed from institutions in India, Nigeria, Sudan, Ghana, Ethiopia, and Bangladesh, and were primarily to within-country national agricultural research centers and to other (unspecified) users (Khoury *et al.*, 2025). In the Plant Treaty dataset, the providers of okra samples were located in China, Canada, and Tanzania, and the recipients of the most samples were located in China, India, Zimbabwe, Canada, Thailand, and the Philip-

pines. The differences in numbers of samples distributed as recorded by FAO WIEWS versus the Plant Treaty Data Store is likely a reflection of the lack of inclusion of the crop in Annex 1 of the Plant Treaty (Khoury *et al*., 2023).

In addition to these distribution statistics, since 2013 the World Vegetable Center has distributed many okra samples to farmers, mainly in East Africa, through seed kits (Stoilova *et al.*, 2019).

Table 7. Okra germplasm distributions and varietal registrations and releases. FAO WIEWS distributions data is annual average over years 2014 to 2019. Plant Treaty Data Store distributions data is annual average over years 2015 to 2021. Evenness metric quantifies evenness of germplasm distributions across world regions, where 0 equals highly uneven and 1 equals completely even. International Union for the Protection of New Varieties of Plants (UPOV) PLUTO data is annual average over years 2014 to 2018. FAO WIEWS varietal releases data is annual average over years 2015 to 2019. All metrics data from Khoury *et al.* (2023), with Plant Treaty Data Store additions for more recent years (2019 to 2021).

Metric	Number
Average annual number of accessions distributed worldwide as recorded in FAO WIEWS	1,141.8
Average annual number of samples distributed worldwide as recorded in FAO WIEWS	1,556.2
Average annual number of samples distributed worldwide as recorded in the Plant Treaty Data Store	277.9
Number of countries receiving germplasm as recorded in the Plant Treaty Data Store	4.7
Evenness of distributions across world regions as recorded in the Plant Treaty Data Store	0.6
Average annual number of varietal registrations worldwide as recorded in UPOV's PLUTO	0.8
Average annual number of varietal releases worldwide as recorded in FAO WIEWS	7.0

Networks and partnerships

- An international Okra Genetic Resources Network was active in the 1990s.
- Currently active networks focused on the crop include:
  - The Asia and Pacific Seed Association (APSA)-World Vegetable Center (WorldVeg) Vegetable Breeding Consortium
  - The African Orphan Crops Consortium
  - The African Vegetable Biodiversity Rescue Plan
  - The Vision for Adapted Crops and Soils (VACS)

Conclusions

world regions, and may become more important in future food systems for both human nutrition and sustainable agriculture. Its genetic resources are bolstered by the activities taking place in collections in national and subnational agricultural research organizations as well as at the World Vegetable Center. Available data indicates that these collections, in combination, are diverse and extensive, although they do not represent the full range of crop varieties as well as species and populations of wild relatives that could be conserved *ex situ* and made available for use. Lack of inclusion of the crop in Annex 1 of the Plant Treaty constrains international access to germplasm, with only around 17.6% of total accessions worldwide currently included in the MLS. There are considerable amounts of associated research resources (with some gaps), and there has been significant activity in germplasm distributions for the crop. Further efforts are required to: identify/determine taxa within current *ex situ* accessions; regenerate accessions in need; fully secure these accessions in long-term seed storage conditions and safety backup all unique accessions, including at the SGSV; and provide more complete accession-level passport information as well as generate further characterization and evaluation datasets.

MICHAEL MAJOR

Methods and materials

Primary data sources for the metrics reported in this summary include: Genesys; World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture of the Food and Agriculture Organization of the United Nations (FAO WIEWS); Botanic Gardens Conservation International PlantSearch database (BGCI PlantSearch); Global Information System of the International Treaty on Plant Genetic Resources for Food and Agriculture (Plant Treaty GLIS); Data Store of the International Treaty on Plant Genetic Resources for Food and Agriculture (Plant Treaty Data Store); Svalbard Global Seed Vault portal (SGSV portal); International Union for the Protection of New Varieties of Plants (UPOV) PLUTO database; FAOSTAT; National Center for Biotechnology Information's Entrez database (NCBI Entrez); Google Scholar; PubMed Central; Wikipedia; and the Global Biodiversity Information Facility (GBIF). Some of these data were acquired from literature/databases including Khoury et al. (2023) and Khoury et al. (2025). Data processing, metric calculation, and table generation were conducted in R, with code available on this GitLab repository. Extended methods are available here.

Acknowledgements

The development of this document was funded by the German Federal Ministry of Agriculture, Food and Regional Identity (BMLEH) as part of the project *Mainstreaming Global Crop Conservation Strategies in Plant Treaty Processes* led by the Crop Trust. The Crop Trust cooperated with the Secretariat of the International Treaty on Plant Genetic Resources for Food and Agriculture in the development of this document.

References

FAO (2009) *The International Treaty on Plant Genetic Resources for Food and Agriculture*. Food and Agriculture Organization of the United Nations (FAO), Rome, Italy. https://openknowledge.fao.org/server/api/core/bitstreams/a9d0de2a-8e98-4f75-98a8-6730788841030/content

FAO (2025a) FAOSTAT. https://www.fao.org/faostat/en/#data (accessed September 2025)

FAO (2025b) *The Third Report on The State of the World's Plant Genetic Resources for Food and Agriculture*. FAO: Rome. https://doi.org/10.4060/cd4711en

International Board for Plant Genetic Resources (IBPGR)/International Plant Genetic Resources Institute (IPGRI) (1993) *Register of Base Collections*. https://www.researchgate.net/profile/Johannes-Engels-2/publication/329175759_Registry_of_Base_Collections_Engels_and_Thormannpdf/data/5bfa7fcfa6fdcc538819a20e/Registry-of-Base-Collections-Engels-and-Thormann.pdf?origin=publication_list

Khoury CK, Sotelo S, Amariles D, and Hawtin G (2023) *The Plants That Feed the World: baseline data and metrics to inform strategies for the conservation and use of plant genetic resources for food and agriculture*. International Treaty on Plant Genetic Resources for Food and Agriculture Rome: Food and Agricultural Organization of the United Nations. doi: 10.4060/cc6876en. https://www.fao.org/documents/card/en/c/cc6876en

Khoury CK, Sotelo S, Hawtin G, Halewood M, Lopez Noriega I, and Lusty C (2025) Germplasm exchange: Thematic Study for *The Third Report on the State of the World's Plant Genetic Resources for Food and Agriculture*. Rome: Food and Agricultural Organization of the United Nations. doi: 10.4060/cd4850en. https://doi.org/10.4060/cd4850en

Kyriakopoulou OG, Arens P, Pelgrom KTB, Karapanos I, Bebeli P, and Passam HC (2014) Genetic and morphological diversity of okra (*Abelmoschus esculentus* [L.] Moench.) genotypes and their possible relationships, with particular reference to Greek landraces. *Scientia Horticulturae* 171: 58–70. https://doi.org/10.1016/j.scienta.2014.03.029

Sandeep N, Dushyanthakumar BM, Sridhara S, Dasaiah L, Mahadevappa Satish K, El-Shehawi AM, *et al.* (2022) Characterization of Okra Species, Their Hybrids and Crossability Relationships among *Abelmoschus* Species of the Western Ghats Region. *Horticulturae*. 8(7): 587. https://doi.org/10.3390/horticulturae8070587

Stoilova T, Van Zonneveld M, Roothaert R, and Schreinemachers P (2019) Connecting genebanks to farmers in East Africa through the distribution of vegetable seed kits. *Plant Genet Resour.* 17(03): 306–309. https://doi.org/10.1017/S1479262119000017

Suma A, Joseph John K, Bhat KV, Latha M, Lakshmi CJ, Pitchaimuthu M, *et al.* (2023) Genetic enhancement of okra [*Abelmoschus esculentus* (L.) Moench] germplasm through wide hybridization. *Front Plant Sci.* 14:1284070. https://doi.org/10.3389/fpls.2023.1284070

Thormann I, Engels JMM, and Halewood M (2019) Are the old International Board for Plant Genetic Resources (IBPGR) base collections available through the Plant Treaty's multilateral system of access and benefit sharing? A review. *Genet Resour Crop Evol.* 66(2): 291–310. https://doi.org/10.1007/s10722-018-0715-5

USDA (2025) Global Global Taxonomy. https://npgsweb.ars-grin.gov/gringlobal/taxon/taxonomysearch (accessed September 2025)

Van Hintum T, Menting F, and Van Strien E (2011) Quality indicators for passport data in *ex situ* genebanks. *Plant Genetic Resources* 9(3): 478–485. https://doi.org/10.1017/S1479262111000682

World Flora Online WFO (2025) *Abelmoschus* Medik. http://www.worldfloraonline.org/taxon/wfo-4000000031 (accessed October 2025)

World Vegetable Center (WorldVeg) (2021) World Vegetable Center Genebank morphological descriptors. https://worldveg.tind.io/record/75880/?v=pdf (accessed November 2025)

Supplementary Information

Supplementary Table 1: Full list of *ex situ* collections of okra genetic resources, in descending order by total number of accessions. Number of accessions and storage condition information from Genesys and FAO WIEWS (2025), with supplementary information as noted. Multilateral System (MLS) status from Plant Treaty GLIS (2025) and from Genesys and FAO WIEWS (2025).

Institution Code	Institution name	Number of accessions	Percent of total	Cumulative percent	Number of accessions in long term storage (-18-20 C)	Number of accessions included in MLS (from Plant Treaty GLIS)	Number of accessions included in MLS (from genebank collections databases)
IND001	National Bureau of Plant Genetic Resources	3,581	21.1%	21.1%	3,578	0	0
USA016	Plant Genetic Resources Conservation Unit, Southern Regional Plant Introduction Station, University of Georgia, USDA-ARS	2,990	17.6%	38.8%	Not listed	0	0
TWN001	World Vegetable Center	2,567	15.2%	53.9%	2,059	1,724	2,151
BEN097	Unité de Génétique, Biotechnologie et Science des Semences	1,625	9.6%	63.5%	Not listed	1,624	0
GHA091	Plant Genetic Resources Research Institute	822	4.8%	68.4%	Not listed	27	28
SDN002	Agricultural Plant Genetic Resources Conservation and Research Centre	683	4.0%	72.4%	683	0	0
TUR001	Plant Genetic Resources Department	626	3.7%	76.1%	626	0	0
NGA010	National Centre for Genetic Resources and Biotechnology	423	2.5%	78.6%	423	422	422
UZB006	Uzbek Research Institute of Plant Industry	341	2.0%	80.6%	Not listed	0	0
ZMB048	National Plant Genetic Resources Centre	235	1.4%	82.0%	235	138	0
BRA003	Embrapa Recursos Genéticos e Biotecnologia	199	1.2%	83.2%	Not listed	0	0
EGY087	National Gene Bank	173	1.0%	84.2%	Not listed	0	0
NGA003	National Horticultural Research Institute	165	1.0%	85.2%	Not listed	0	0
PAK001	Plant Genetic Resources Program	158	0.9%	86.1%	90	0	117
JPN183	NARO Genebank	157	0.9%	87.0%	50	0	0
LKA036	Plant Genetic Resources Centre	147	0.9%	87.9%	Not listed	0	0
BGD003	Bangladesh Agricultural Research Institute	144	0.8%	88.7%	127	0	15
USA974	Seed Savers Exchange	136	0.8%	89.5%	Not listed	0	0
BGD206	Lal Teer Seed Limited	131	0.8%	90.3%	131	0	0
JOR105	National Agricultural Research Center	126	0.7%	91.0%	Not listed	0	0
ZMB030	SADC Plant Genetic Resources Centre	123	0.7%	91.8%	123	0	0

Institution Code	Institution name	Number of accessions	Percent of total	Cumulative percent	Number of accessions in long term storage (-18-20 C)	Number of accessions included in MLS (from Plant Treaty GLIS)	Number of accessions included in MLS (from genebank collections databases)
CAN004	Plant Gene Resources of Canada, Saskatoon Research and Development Centre	93	0.6%	92.3%	93	0	93
ETH085	Ethiopian Biodiversity Institute	93	0.6%	92.9%	12	0	0
PHL129	Institute of Plant Breeding-National Plant Genetic Resources Laboratory	74	0.4%	93.3%	Not listed	0	0
TCD022	Institut Tchadien de Recherche Agronomique pour le Développement	74	0.4%	93.7%	Not listed	78	0
CUB014	Instituto de Investigaciones Fundamentales en Agricultura Tropical	58	0.3%	94.1%	Not listed	0	0
BRA012	Embrapa Hortaliças	56	0.3%	94.4%	Not listed	0	0
NPL069	National Agriculture Genetic Resources Centre-Genebank	56	0.3%	94.7%	56	0	0
NER001	Institut national de la recherche agronomique du Niger	53	0.3%	95.1%	53	0	0
ZAF062	RSA National Plant Genetic Resources Centre	52	0.3%	95.4%	51	0	0
DEU146	Genebank, Leibniz Institute of Plant Genetics and Crop Plant Research	46	0.3%	95.6%	46	0	0
TZA016	National Plant Genetic Resources Centre	43	0.2%	95.9%	43	0	0
ARE003	International Center for Biosaline Agriculture	40	0.2%	96.1%	Not listed	40	40
UGA132	Plant Genetic Resource Centre	39	0.2%	96.4%	39	0	0
UGA528	Uganda National Genebank	39	0.2%	96.6%	Not listed	0	0
PNG004	Southern Regional Centre Laloki (NARI)	36	0.2%	96.8%	Not listed	0	36
BGR001	Institute for Plant Genetic Resources 'K.Malkov'	35	0.2%	97.0%	Not listed	0	0
ZWE049	Genetic Resources and Biotechnology Institute-Department of Research and Specialist Services	33	0.2%	97.2%	Not listed	0	0
SAU015	Plant Genetic Resources Bank	31	0.2%	97.4%	Not listed	0	31
VNM049	Plant Resources Center	30	0.2%	97.6%	Not listed	0	0
BGD099	Bangladesh Rural Advancement Committee (BRAC)	29	0.2%	97.7%	Not listed	0	0
NGA136	Biodiversity Education and Resource Centre	28	0.2%	97.9%	Not listed	0	0
MDG048	Laboratoire des semences et ressources phytogénétiques, FOFIFA	24	0.1%	98.0%	Not listed	0	0

Institution Code	Institution name	Number of accessions	Percent of total	Cumulative percent	Number of accessions in long term storage (-18-20 C)	Number of accessions included in MLS (from Plant Treaty GLIS)	Number of accessions included in MLS (from genebank collections databases)
BGD215	Advanced Seed Research & Biotech Centre	23	0.1%	98.2%	Not listed	0	0
FJI049	Centre for Pacific Crops and Trees	23	0.1%	98.3%	Not listed	10	0
ALB026	Plant Genetic Resources Center	17	0.1%	98.4%	17	0	0
PNG041	Momase Regional Centre, Bubia	15	0.1%	98.5%	Not listed	0	15
TTO010	Central Experiment Station, Research Division, Ministry of Agriculture, Land and Fisheries	15	0.1%	98.6%	Not listed	0	0
GUY021	National Agricultural Research and Extension Institute	13	0.1%	98.7%	Not listed	0	0
GRC100	CIHEAM Mediterranean Agronomic Institute of Chania	12	0.1%	98.7%	12	0	0
PNG001	Islands Regional Centre Keravat	12	0.1%	98.8%	Not listed	0	12
USA995	National Center for Genetic Resources Preservation	12	0.1%	98.9%	Not listed	0	0
ERI003	National Agricultural Research Institute	11	0.1%	98.9%	11	0	0
GBR004	Millennium Seed Bank - Royal Botanic Gardens Kew	11	0.1%	99.0%	Not listed	0	0
ISR002	Israel Gene Bank for Agricultural Crops, Agricultural Research Organisation, Volcani Center	11	0.1%	99.1%	10	0	0
NGA026	Obafemi Awolowo University	11	0.1%	99.1%	Not listed	0	0
BGD001	Bangladesh Jute Research Institute (BJRI)	9	0.0%	99.2%	9	0	0
MKD001	Faculty of Agriculture, University Ss. Cyril and Methodius	9	0.0%	99.2%	Not listed	0	0
SWZ015	National Plant Genetic Resources Centre	8	0.0%	99.3%	8	0	0
BGD028	Bangladesh Institute of Nuclear Agriculture (BINA)	7	0.0%	99.3%	Not listed	0	0
GRC005	Greek Genebank, Institute of Plant Breeding and Genetic Resources	7	0.0%	99.4%	Not listed	0	0
KEN212	Genetic Resources Research Institute	7	0.0%	99.4%	7	0	0
POL003	Plant Breeding and Acclimatization Institute	7	0.0%	99.5%	7	0	0
BFA084	Commission nationale de gestion des ressources phytogenetiques	6	0.0%	99.5%	Not listed	0	0
MMR015	Myanmar SeedBank	6	0.0%	99.5%	Not listed	0	0

Institution Code	Institution name	Number of accessions	Percent of total	Cumulative percent	Number of accessions in long term storage (-18-20 C)	Number of accessions included in MLS (from Plant Treaty GLIS)	Number of accessions included in MLS (from genebank collections databases)
LBN002	International Centre for Agricultural Research in Dry Areas	5	0.0%	99.6%	Not listed	0	0
BIH036	Faculty of Agriculture and Food Sciences, University of Sarajevo	4	0.0%	99.6%	Not listed	0	0
MWI041	Malawi Plant Genetic Resources Centre	4	0.0%	99.6%	4	0	2
TUN029	Banque Nationale de Gènes de Tunisie	4	0.0%	99.6%	4	0	0
UKR008	Ustymivka Experimental Station of Plant Production	4	0.0%	99.7%	Not listed	0	0
UKR021	Institute of Vegetable and Melon Growing	4	0.0%	99.7%	2	0	0
ARM008	Scientific Centre of Vegetable and Industrial Crops	3	0.0%	99.7%	Not listed	0	3
AZE015	Genetic Resources Institute	3	0.0%	99.7%	Not listed	0	0
CRI001	Centro Agronómico Tropical de Investigación y Enseñanza	3	0.0%	99.7%	3	3	3
GRC047	Vegetable Department, Institute of Plant Breeding and Genetic Resources	3	0.0%	99.7%	Not listed	0	0
HUN003	Centre for Plant Diversity	3	0.0%	99.8%	Not listed	0	3
RUS001	N.I. Vavilov All-Russian Research Institute of Plant Industry	3	0.0%	99.8%	Not listed	0	0
BEL002	Gembloux agro-biotech, Université de Liège, département des Sciences agronomiques, Phytotechnie tropicale et Horticulture	2	0.0%	99.8%	Not listed	0	2
HRV045	Faculty of Agrobiotechnical Sciences Osijek, University J.J. Strossmayer in Osijek	2	0.0%	99.8%	Not listed	0	0
MEX006	UACh, Banco Nacional de Germoplasma Vegetal (BANGEV)	2	0.0%	99.8%	2	0	0
MEX208	INIFAP, Centro Nacional de Recursos Genéticos (CNRG)	2	0.0%	99.8%	2	0	0
MKD007	Fabia CSB Bogdanci	2	0.0%	99.8%	Not listed	0	0
PHL024	Bureau of Plant Industry-Davao National Crop Research and Development Center	2	0.0%	99.9%	Not listed	0	0
ROM019	Research and Development Institute for Vegetables and Floriculture Vidra	2	0.0%	99.9%	Not listed	0	0
USA151	National Arboretum-Germplasm Unit, USDA/ARS	2	0.0%	99.9%	Not listed	0	0
ARM005	Institute of Botany	1	0.0%	99.9%	Not listed	0	0

Institution Code	Institution name	Number of accessions	Percent of total	Cumulative percent	Number of accessions in long term storage (-18-20 C)	Number of accessions included in MLS (from Plant Treaty GLIS)	Number of accessions included in MLS (from genebank collections databases)
ARM059	Agrobiotechnology Scientific Center	1	0.0%	99.9%	1	0	0
AUT001	Austrian Agency for Health and Food Safety	1	0.0%	99.9%	1	0	0
AUT025	Referat Pflanzengesundheit und Spezialkulturen	1	0.0%	99.9%	1	0	0
AZE014	Azerbaijan State Agrarian University	1	0.0%	99.9%	Not listed	0	0
BGD014	Bangladesh Forest Research Institute (BFRI)	1	0.0%	99.9%		0	0
BIH039	Institute of Genetic Resources, University of Banja Luka	1	0.0%	99.9%	1	0	0
CYP004	National (CYPARI) Genebank, Agricultural Research Institute, Ministry of Agriculture, Rural Development and Environment	1	0.0%	99.9%	1	0	0
ECU023	Departamento Nacional de Recursos Fitogenéticos	1	0.0%	99.9%	1	0	0
ECU330	Estación Experimental Tropical Pichilingue	1	0.0%	99.9%	Not listed	0	0
ESP004	Centro Nacional de Recursos Fitogenéticos	1	0.0%	99.9%	Not listed	0	0
ESP027	Gobierno de Aragón. Centro de Investigación y Tecnología Agroalimentaria. Banco de Germoplasma de Hortícolas	1	0.0%	99.9%	1	0	0
LBN020	Lebanese Agricultural Research Institute	1	0.0%	100.0%	1	0	0
LBY006	National Bank for Plant Genetic Resources	1	0.0%	100.0%	Not listed	0	0
NAM006	National Plant Genetic Resources Centre	1	0.0%	100.0%	1	0	0
PHL200	Department of Agriculture - Region 2	1	0.0%	100.0%	Not listed	0	0
PRT102	Banco de Germoplasma - Universidade da Madeira	1	0.0%	100.0%	Not listed	0	1
QAT004	Biotechnology Center, Ministry of Environment	1	0.0%	100.0%	1	1	1
ROM007	Suceava Genebank	1	0.0%	100.0%	1	0	0
TUR034	Field Crop Central Research Institute	1	0.0%	100.0%	1	0	0
UKR019	Research Station of Medicinal Crops	1	0.0%	100.0%	1	0	0

Supplementary Table 2: Full list of taxonomic names in *ex situ* genetic resource collections, in descending order by number of accessions conserved. Germplasm data from Genesys and FAO WIEWS (2025).

Taxon	Number of accessions (from genebank collections databases)
Abelmoschus esculentus (L.) Moench	13,652
Abelmoschus Medik.	1,201
Abelmoschus caillei (A. Chev.) J. M. C. Stevels	671
Abelmoschus manihot (L.) Medik.	592
Abelmoschus manihot subsp. *tetraphyllus* (Roxb. ex Hornem.) Borss. Waalk.	314
Abelmoschus moschatus Medik.	255
Abelmoschus ficulneus (L.) Wight & Arn.	174
Abelmoschus angulosus Wight & Arn.	30
Abelmoschus manihot var. *pungens* (Roxb.) Hochr.	30
Abelmoschus crinitus Wall.	11
Abelmoschus hybr.	8
Abelmoschus moschatus subsp. *moschatus*	4
Abelmoschus sagittifolius Merr.	4
Abelmoschus manihot subsp. *manihot*	3

THE GLOBAL CROP DIVERSITY TRUST
Platz der Vereinten Nationen 7
53113 Bonn
Germany

PUBLICATIONS CONTACT
publications@croptrust.org

GENERAL CONTACT
info@croptrust.org

CROP TRUST