GLOBAL CROP CONSERVATION AND USE METRICS

AMARANTH
(*Amaranthus* L.)

CROP TRUST

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With support from

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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 amaranth and its wild relatives, including key metrics on:

- global statistics on crop production 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 amaranth

Amaranth (*Amaranthus* L.) crops were in cultivation at least 6,000-8,000 years ago in South and Central America, eventually becoming staple foods for civilizations such as the Aztecs, Mayas, and Incas (Brenner *et al.*, 2020; Priyadarsini *et al.*, 2025). Traditional use of the plants in religious ceremonies led to banning of its cultivation by Spanish conquistadors in the 16th century, but the food persisted and spread to other continents both as a grain and a leaf vegetable, and has experienced a further revival in the past half century (Sauer, 1967; Baraniak and Kania-Dobrowolska, 2022). The genus contains three main species cultivated for their "grains" (being in the Amaranthaceae, they are considered pseudocereals rather than true cereals of the grass family): *Amaranthus cruentus* L. and *Amaranthus hypochondriacus* L. (native to Mesoamerica), and *Amaranthus caudatus* L. (kiwicha, native to the South American Andes). These are now cultivated across many tropical, subtropical, and warm temperate regions worldwide (Sarker *et al.*, 2020; USDA, 2025; WFO, 2025). As a vegetable, the genus contains at least 17 species cultivated for their highly nutritious edible leaves. Several amaranth species are also valued for their ornamental characteristics or for animal feed, while many are invasive weeds (Priyadarsini *et al.*, 2025). Amaranth crops are remarkably resilient, having C4 photosynthesis and able to grow in poor soils and challenging climatic conditions (Priyadarsini *et al.*, 2025).

Global cultivation and consumption statistics are rather limited for amaranth, with FAOSTAT placing the crop within generalized categories both in production metrics ("Cereals, nes") and food supply metrics ("Cereals, Other") and not providing information on its use as a vegetable; estimates derived from these statistics are reported in Table 1.

Table 1. Global status of amaranth production, availability in food supplies, and public interest. Production and food supply statistics from FAOSTAT (2015 to 2018 average). The crop is placed within generalized categories both in production metrics ("Cereals, nes") and food supply metrics ("Cereals, Other"). For production, the value for "Cereals, nes" was divided evenly among crops within the general category to estimate a production value. For food supply, the value for "Cereals, Other" was divided among crops within the general category 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)	247,151	1.75	0.14	1.00
Total production (tonnes)	407,690	2.00	0.14	1.00
Gross production value (current thousand USD)	105,242	1.50	0.11	0.99
Contribution to calories in food supplies (kcal/capita/day)	0.50	3.00	0.32	1.00
Contribution to protein in food supplies (g/capita/day)	0.01	4.25	0.32	0.99
Contribution to fat in food supplies (g/capita/day)	0.00	0.75	0.33	0.97
Contribution to food weight in food supplies (g/capita/day)	0.05	1.25	0.29	1.00
Number of public pageviews on Wikipedia over one year	150,787			

Identity and composition of *ex situ* collections

Based on the latest data in global genetic resource databases, germplasm collections of amaranths and their wild relatives (i.e., genus *Amaranthus* L.) are present in at least 118 institutions worldwide, collectively maintaining 25,838 accessions (Table 2, Table 3; Supplementary Table 1). The institutions include large collections in the Americas, Asia, Europe, and Africa. The World Vegetable Center maintains a large international collection for the crop (with a focus on its use as a leaf vegetable), with the International Center for Biosaline Agriculture and Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) also maintaining international collections. The largest national collections are in India (with 24.3% of total accessions worldwide), USA (12.9%), and Brazil (9.7%), as well as Benin, Mexico, Bangladesh, Hungary, Peru, Japan, and Ecuador; these international and large national collections collectively maintain over three-quarters of documented accessions worldwide.

The number of amaranth accessions represented in global databases is somewhat more than the number of accessions reported for the crop (23,433) 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). This said, the collections listed in online databases are not representative of all amaranth collections globally. For example, the collections of the Centro de Investigación de Cultivos Andinos at the Universidad Nacional de San Antonio Abad del Cusco, Peru, is known to maintain over 1,500 accessions of *A. caudatus* and is not currently reported.

Table 2. Major *ex situ* collections of amaranth 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	6,277	24.3%	24.3%	6,277	0	0
USA020	North Central Regional Plant Introduction Station, USDA-ARS, NCRPIS	3,341	12.9%	37.2%	3,156	0	0
BRA003	Embrapa Recursos Genéticos e Biotecnologia	2,496	9.7%	46.9%	Not listed	0	0
TWN001	World Vegetable Center	1,432	5.5%	52.4%	1,325	536	1,083
BEN097	Unité de Génétique, Biotechnologie et Science des Semences	1,220	4.7%	57.1%	Not listed	1,220	0
MEX208	INIFAP, Centro Nacional de Recursos Genéticos (CNRG)	893	3.5%	60.6%	893	0	0
BGD003	Bangladesh Agricultural Research Institute	794	3.1%	63.7%	779	0	50
HUN003	Centre for Plant Diversity	787	3.0%	66.7%	21	0	5
PER012	Estación Experimental Agraria Baños del Inca	685	2.6%	69.4%	Not listed	0	0
JPN183	NARO Genebank	680	2.6%	72.0%	261	0	0
ECU023	Departamento Nacional de Recursos Fitogenéticos	589	2.3%	74.3%	523	0	0
MEX194	Instituto de Investigación y Capacitación Agropecuaria, Acuícola y Forestal del Estado de México (ICAMEX)	430	1.7%	76.0%	Not listed	0	0
ARE003	International Center for Biosaline Agriculture	415	1.6%	77.6%	Not listed	416	415
MEX006	UACh, Banco Nacional de Germoplasma Vegetal (BANGEV)	412	1.6%	79.2%	191	0	0
CRI001	Centro Agronómico Tropical de Investigación y Enseñanza (CATIE)	265	1.0%	80.2%	265	265	265
ZMB048	National Plant Genetic Resources Centre	260	1.0%	81.2%	260	7	0
VNM049	Plant Resources Center	258	1.0%	82.2%	Not listed	0	0

GBR004	Millennium Seed Bank - Royal Botanic Gardens Kew	243	0.9%	83.1%	Not listed	0	0
NPL069	National Agriculture Genetic Resources Centre-Genebank	218	0.8%	84.0%	218	0	0
BOL317	Estación Experimental de Toralapa	216	0.8%	84.8%	Not listed	0	0
	Other institutions (n = 98)	3,927	15.2%	100.0%	1,744	580	787

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 amaranth:

- National Bureau of Plant Genetic Resources (NBPGR) (India) – regional collection for Asia (agreement dated 1981)
- USDA National Plant Germplasm System (NPGS) (USA) – global collection (agreement dated 1980)

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

The genus *Amaranthus* L. (Amaranthaceae) contains around 50 species native to all continents, in both temperate and tropical regions; many inhabit open and disturbed areas and have the capacity to be weeds (USDA, 2025b; WFO, 2025). A published genepool concept is available for red grain amaranth (*Amaranthus cruentus* L.) (USDA, 2025b). The concept considers *Amaranthus hybridus* L. the putative progenitor; this species is native to the Americas, from Canada south to Bolivia, and including the Caribbean Islands.

The secondary genepool contains three taxa:
Amaranthus powellii S. Watson
Amaranthus retroflexus L.
Amaranthus wrightii S. Watson

The tertiary genepool contains five taxa:
Amaranthus acutilobus Uline & W. L. Bray
Amaranthus dubius Mart. ex Thell.
Amaranthus hybridus L.
Amaranthus palmeri S. Watson
Amaranthus quitensis Kunth

Data compilation for this report on amaranth genetic resources included all taxa in *Amaranthus*. Approximately 65 taxonomic names are present in germplasm collections, including the crop species as well as hybrids and accessions only determined at the genus level (Supplementary Table 2).

Landraces make up the largest proportion of known collections (34%), followed by improved varieties (9.2%), wild relatives (5.6%), and breeding materials (3.4%) (Table 3); these percentages are estimates based on available data, noting that 46.5% of accessions do not have biological status data. Amaranth germplasm has been collected from at least 117 countries, with at least 15.6% of accessions originating from the primary region of diversity of the crops (i.e. Mesoamerica and Andean South America, East Africa, and East and South Asia); these statistics are also estimates, as over 10% of amaranth landrace accessions and a similar proportion 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 139 botanic gardens collectively conserve 62 *Amaranthus* taxa; comparing these to genebank collections, seven are present only in botanic gardens.

Table 3. Composition of *ex situ* collections of amaranth 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	25,838	
Number of institutions holding genebank collections	118	
Number of distinct taxonomic names in genebank collections	65	
Number of accessions of crop wild relatives (CWR) in genebank collections	1,444	5.6%
Number of accessions of weedy materials in genebank collections	236	0.9%
Number of accessions of landraces in genebank collections	8,785	34.0%
Number of accessions of breeding materials in genebank collections	871	3.4%
Number of accessions of improved varieties in genebank collections	2,382	9.2%
Number of accessions of other materials in genebank collections	103	0.4%
Number of accessions not marked with an improvement type in genebank collections	12,017	46.5%
Number of countries where germplasm has been collected for genebank collections	117	
Number of accessions in genebank collections from the primary region(s) of diversity	4,022	15.6%
Number of taxa in botanic garden collections	62	
Number of botanic gardens holding collections of crop or its wild relatives	139	

Multilateral System status of accessions in *ex situ* collections

The genus *Amaranthus* 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, institutions can voluntarily place their collections under the MLS. Of the 25,838 accessions conserved globally, approximately 8.8% are held in international institutions (mainly the World Vegetable Center), 7% of which are listed as included in the MLS of the Plant Treaty, with the remainder maintained in national and other collections (Table 4).

As of 2025, 3,024 accessions are formally included in the MLS according to the Plant Treaty's GLIS database, and 4,492 accessions have been assigned Digital Object Identifiers (DOIs). Per the relevant fields in the global genetic resources databases, 2,605 accessions (10.1% of world total) are listed as included in the MLS; this is likely to be an underestimate, noting that 75.2% of accessions do not have MLS status data.

Table 4. Representation of amaranth 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	2,282	8.8%
Number of accessions in genebank collections in national or other institutions	23,941	92.7%
Number of accessions in genebank collections in Annex I	0	0%
Number of accessions with DOI (Plant Treaty GLIS 2025)	4,492	
Number of accessions included in the Multilateral System (MLS) (Plant Treaty GLIS 2025)	3,024	
Number of accessions included in the Multilateral System (MLS) (genebank collections databases)	2,605	10.1%
Number of accessions included in the Multilateral System (MLS) that are in international collections (genebank collections databases)	1,813	7.0%
Number of accessions not included in the Multilateral System (MLS) (genebank collections databases)	3,801	14.7%
Number of accessions without information regarding inclusion in the Multilateral System (MLS) (genebank collections databases)	19,432	75.2%

Storage conditions, regeneration status, and safety duplication

As expected for an orthodox seed crop, the great majority (at least 83.4%) of *Amaranthus* accessions are conserved as seed, with 73.8% of these accessions listed as conserved under long-term cold-storage conditions (Table 5). Information on storage in general is missing for 15.8% of all accessions, and information on seed storage type (i.e., long, medium, or short term) is missing for 3.7% 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 1279 amaranth accessions regenerated during this time by reporting institutions, with 1,315 accessions identified as needing regeneration and 1204 of these lacking funds to conduct the regeneration.

Analysis of the location of safety duplication sites of amaranth germplasm, as listed in Genesys, indicates that at least 10% 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 amaranth 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 safety backup their collections in a different location within the country. Information from the SGSV database from 2025 indicates that approximately 15.3% of total accessions worldwide are duplicated in Svalbard.

Table 5. Storage conditions of amaranth *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 2012 to 2014. 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	21,559	83.4%
Number of accessions held in short-term seed storage in genebank collections	10	0.0%
Number of accessions held in medium-term seed storage in genebank collections	4,834	22.4%
Number of accessions held in long-term seed storage in genebank collections	15,913	73.8%
Number of accessions held in seed storage of undefined type in genebank collections	802	3.7%
Number of accessions held in field storage in genebank collections	729	2.8%
Number of accessions held in in-vitro storage in genebank collections	1	0.0%
Number of accessions held in cryo storage in genebank collections	5	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	4,079	15.8%
Number of accessions in genebank collections regenerated 2014-2019	1,279	36.5%
Number of accessions in genebank collections in need of regeneration 2014-2019	1,315	37.5%
Number of accessions in genebank collections in need of regeneration without budget for regeneration 2014-2019	1,204	34.4%
Number of accessions safety duplicated out of the country in genebank collections	919	10.0%
Number of accessions in genebank collections safety duplicated in Svalbard	3,942	15.3%

Documentation, information systems, and research resources

The World Vegetable Center published a descriptor in 2015 (WorldVeg, 2015). A characterized core collection for amaranth has also been established at the World Vegetable Center (Schafleitner *et al.*, 2022). Several national collections use descriptors for amaranth, such as India (see Pandey *et al.*, 2015) and the USA (USDA, 2025a).

The estimated completeness of passport information for amaranth accessions listed in Genesys is 5.5 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 six amaranth characterization and evaluation datasets are available via Genesys, covering a total of 1,254 accessions. Four metrics of the current degree of digital sequence information (DSI) for amaranth (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.

Table 6. Documentation, information systems, and research resources for amaranth. 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	5.5
Number of genes as recorded in NCBI's Entrez database as of 2022	243
Number of genomes as recorded in NCBI's Entrez database as of 2022	3
Number of nucleotides as recorded in NCBI's Entrez database as of 2022	239,810
Number of proteins as recorded in NCBI's Entrez database as of 2022	1,893
Number of publications listed in Google Scholar with taxon name in title published between 2009 and 2019	347
Number of publications listed in PubMed Central with taxon name in text as of 2022	2,662
Number of research materials as recorded in GBIF (2025)	492,647

Germplasm distributions and varietal registrations and releases

Germplasm distribution and varietal development statistics for amaranth 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 16 countries, with the largest numbers of samples distributed from institutions in Nigeria, India, Nepal, Bangladesh, and Mexico, and were primarily to within-country national agricultural research centers and to farmers or non-governmental organizations (NGOs) (Khoury *et al.*, 2025). In the Plant Treaty dataset, the providers of the most samples were located in China and Tanzania, and the recipients of the most samples were located in Malaysia, China, Tanzania, Kenya, and Papua New Guinea. 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 crops 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 amaranth samples to farmers, mainly in East Africa, through seed kits (Stoilova *et al.*, 2019).

Table 7. Amaranth 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	514.4
Average annual number of samples distributed worldwide as recorded in FAO WIEWS	932.2
Average annual number of samples distributed worldwide as recorded in the Plant Treaty Data Store	217.6
Number of countries receiving germplasm as recorded in the Plant Treaty Data Store	5.3
Evenness of distributions across world regions as recorded in the Plant Treaty Data Store	0.7
Average annual number of varietal registrations worldwide as recorded in UPOV's PLUTO	2.5
Average annual number of varietal releases worldwide as recorded in FAO WIEWS	2.5

Networks and partnerships

Currently active networks focused on the crop include:

- The Asia and Pacific Seed Association (APSA)-World Vegetable Center (WorldVeg) Vegetable Breeding Consortium
- The Africa Vegetable Breeding Consortium (AVBC)
- The African Orphan Crops Consortium
- The African Vegetable Biodiversity Rescue Plan
- The Vision for Adapted Crops and Soils (VACS)
- The USDA ARS New Crops Germplasm Committee (also here)
- Communities related to amaranth genetics and genomics, e.g. https://amaranthgdb.org/, Gonçalves-Dias and Setter (2021), and Singh *et al.* (2023).

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Conclusions

Amaranth is an important grain and vegetable crop in many world regions, and may become more important in future food systems for both human nutrition and sustainable agriculture needs. Amaranth 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 and several other international institutions. 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 10.1% of total accessions worldwide currently included in the MLS. There are considerable amounts of associated research resources, 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, especially, 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.

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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.

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Supplementary information

Supplementary Table 1: Full list of *ex situ* collections of amaranth 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	6,277	24.3%	24.3%	6,277	0	0
USA020	North Central Regional Plant Introduction Station, USDA-ARS, NCRPIS	3,341	12.9%	37.2%	3,156	0	0
BRA003	Embrapa Recursos Genéticos e Biotecnologia	2,496	9.7%	46.9%	Not listed	0	0
TWN001	World Vegetable Center	1,432	5.5%	52.4%	1,325	536	1,083
BEN097	Unité de Génétique, Biotechnologie et Science des Semences	1,220	4.7%	57.1%	Not listed	1,220	0
MEX208	INIFAP, Centro Nacional de Recursos Genéticos (CNRG)	893	3.5%	60.6%	893	0	0
BGD003	Bangladesh Agricultural Research Institute	794	3.1%	63.7%	779	0	50
HUN003	Centre for Plant Diversity	787	3.0%	66.7%	21	0	5
PER012	Estación Experimental Agraria Baños del Inca	685	2.6%	69.4%	Not listed	0	0
JPN183	NARO Genebank	680	2.6%	72.0%	261	0	0
ECU023	Departamento Nacional de Recursos Fitogenéticos	589	2.3%	74.3%	523	0	0
MEX194	Instituto de Investigación y Capacitación Agropecuaria, Acuícola y Forestal del Estado de México (ICAMEX)	430	1.7%	76.0%	Not listed	0	0
ARE003	International Center for Biosaline Agriculture	415	1.6%	77.6%	Not listed	416	415
MEX006	UACh, Banco Nacional de Germoplasma Vegetal (BANGEV)	412	1.6%	79.2%	191	0	0
CRI001	Centro Agronómico Tropical de Investigación y Enseñanza	265	1.0%	80.2%	265	265	265
ZMB048	National Plant Genetic Resources Centre	260	1.0%	81.2%	260	7	0
VNM049	Plant Resources Center	258	1.0%	82.2%	Not listed	0	0
GBR004	Millennium Seed Bank - Royal Botanic Gardens Kew	243	0.9%	83.1%	Not listed	0	0
NPL069	National Agriculture Genetic Resources Centre-Genebank	218	0.8%	84.0%	218	0	0
BOL317	Estación Experimental de Toralapa	216	0.8%	84.8%	Not listed	0	0
KEN212	Genetic Resources Research Institute	209	0.8%	85.6%	1	0	0

NGA010	National Centre for Genetic Resources and Biotechnology	209	0.8%	86.4%	209	209	209
AUS165	Australian Grains Genebank, Agriculture Victoria	184	0.7%	87.1%	184	172	172
GHA091	Plant Genetic Resources Research Institute	180	0.7%	87.8%	Not listed	10	10
MDG048	Laboratoire des semences et ressources phytogénétiques, FOFIFA	176	0.7%	88.5%	Not listed	0	0
DEU146	Genebank, Leibniz Institute of Plant Genetics and Crop Plant Research	159	0.6%	89.1%	159	0	0
USA974	Seed Savers Exchange	145	0.6%	89.7%		0	0
MEX201	UACh, Centro Regional Universitario Sur (CRUS)	142	0.6%	90.2%	Not listed	0	0
RUS001	N.I. Vavilov All-Russian Research Institute of Plant Industry	142	0.6%	90.8%	Not listed	0	0
UGA132	Plant Genetic Resource Centre	130	0.5%	91.3%	130	0	0
UGA528	Uganda National Genebank	130	0.5%	91.8%		0	0
UKR008	Ustymivka Experimental Station of Plant Production	126	0.5%	92.3%	106	0	0
MEX131	UDG, Centro Universitario de Ciencias Biológicas y Agropecuarias (UDG-CUCBA)	121	0.5%	92.7%	Not listed	0	0
ZMB030	SADC Plant Genetic Resources Centre	120	0.5%	93.2%	120	0	0
CZE122	Gene bank	112	0.4%	93.6%	103	1	112
MEX263	SNICS, Depositario Nacional de Referencia de Semillas (DNRS)	112	0.4%	94.1%	Not listed	0	0
ROM007	Suceava Genebank	107	0.4%	94.5%	2	86	86
CMR205	Ecogerm Farmers	104	0.4%	94.9%		0	0
TZA016	National Plant Genetic Resources Centre	93	0.4%	95.3%	93	0	0
BGD206	Lal Teer Seed Limited	84	0.3%	95.6%	84	0	0
ZAF062	RSA National Plant Genetic Resources Centre	80	0.3%	95.9%	79	0	0
ISR002	Israel Gene Bank for Agricultural Crops, Agricultural Research Organisation, Volcani Center	77	0.3%	96.2%	67	0	0
MNG030	Institute of Plant and Agricultural Science	74	0.3%	96.5%		0	5
PAK001	Plant Genetic Resources Program	69	0.3%	96.7%	34	0	67
SVK001	National Agricultural and Food Centre (NPPC), Research Institute of Plant Production (RIPP)	69	0.3%	97.0%	Not listed	0	0
ERI003	National Agricultural Research Institute	51	0.2%	97.2%	51	0	0
ETH085	Ethiopian Biodiversity Institute	51	0.2%	97.4%	51	0	0

ETH013	International Livestock Research Institute	50	0.2%	97.6%	Not listed	50	50
CHL028	Banco Base de Semillas INIA Intihuasi	43	0.2%	97.8%	43	0	0
LKA036	Plant Genetic Resources Centre	43	0.2%	97.9%		0	0
AUS167	Australian Pastures Genebank	40	0.1%	98.1%	40	40	40
UZB006	Uzbek Research Institute of Plant Industry	39	0.1%	98.2%	Not listed	0	0
USA022	Western Regional Plant Introduction Station, USDA-ARS, Washington State University	38	0.1%	98.4%	Not listed	0	0
ZWE049	Genetic Resources and Biotechnology Institute-Department of Research and Specialist Services	29	0.1%	98.5%	Not listed	11	0
UKR021	Institute of Vegetable and Melon Growing	26	0.1%	98.6%	23	0	0
PNG004	Southern Regional Centre Laloki (NARI)	25	0.1%	98.7%	Not listed	0	0
MWI041	Malawi Plant Genetic Resources Centre	20	0.1%	98.8%	20	0	20
SWZ015	National Plant Genetic Resources Centre	18	0.1%	98.8%	18	0	0
BLR014	State research institution 'Institute of Experimental Botany of the National Academy of Sciences of Belarus'	17	0.1%	98.9%	17	0	0
URY003	INIA La Estanzuela	14	0.0%	99.0%	14	0	0
MEX367	Facultad de Ciencias Naturales, Universidad Autónoma de Querétaro	13	0.0%	99.0%	Not listed	0	0
NGA026	Obafemi Awolowo University	13	0.0%	99.1%	Not listed	0	0
NZL001	Margot Forde Genebank, AgResearch Ltd	13	0.0%	99.1%	Not listed	0	0
AZE015	Genetic Resources Institute	12	0.0%	99.2%	1	0	0
BGD215	Advanced Seed Research & Biotech Centre	12	0.0%	99.2%	Not listed	0	0
BGR001	Institute for Plant Genetic Resources 'K.Malkov'	12	0.0%	99.2%	2	0	0
CAN004	Plant Gene Resources of Canada, Saskatoon Research and Development Centre	12	0.0%	99.3%	12	0	12
ARG1350	Banco Activo de Germoplasma de La Consulta	11	0.0%	99.3%	Not listed	0	0
UKR001	Institute of Plant Production n.a. V.Y. Yurjev of UAAS	11	0.0%	99.4%	10	0	0
UKR036	Nikitskyi Botanical Gardens	11	0.0%	99.4%	4	0	0
AUT001	Austrian Agency for Health and Food Safety	8	0.0%	99.5%	6	0	0
ALB026	Plant Genetic Resources Center	7	0.0%	99.5%	7	0	0

BGD099	Bangladesh Rural Advancement Committee (BRAC)	7	0.0%	99.5%	Not listed	0	0
SLV050	CENTA - Banco de Germoplasma	7	0.0%	99.5%	6	0	0
COL017	Corporación Colombiana de Investigación Agropecuaria, AGROSAVIA	6	0.0%	99.6%	6	0	0
GBR017	Henry Doubleday Research Association	6	0.0%	99.6%		0	0
TUN029	Banque Nationale de Gènes de Tunisie	6	0.0%	99.6%	6	0	0
BLR026	The Polessye Institute of Plant Growing	5	0.0%	99.6%	Not listed	0	0
DEU101	Federal Plant Variety Office (Bundessortenamt)	5	0.0%	99.6%	5	0	0
JOR105	National Agricultural Research Center	5	0.0%	99.7%		0	0
LBN020	Lebanese Agricultural Research Institute	5	0.0%	99.7%	5	0	0
MEX166	Secretaría del Medio Ambiente e Historia Natural (SEMAHN), Gobierno de Chiapas	5	0.0%	99.7%	Not listed	0	0
BGD028	Bangladesh Institute of Nuclear Agriculture (BINA)	4	0.0%	99.7%	Not listed	0	0
BWA015	National Plant Genetic Resources Centre	4	0.0%	99.7%	4	0	0
DEU022	Botanical Garden Berlin-Dahlem	4	0.0%	99.7%	Not listed	0	0
FRA098	Station de la Réunion, CIRAD-FLHOR	4	0.0%	99.8%	4	0	0
GBR006	Warwick Genetic Resources Unit	4	0.0%	99.8%	Not listed	0	0
MEX069	UAAAN, Centro de Conservación de Semillas Ortodoxas, Región Norte (CC-SO)	4	0.0%	99.8%	Not listed	0	0
NAM006	National Plant Genetic Resources Centre	4	0.0%	99.8%	1	0	0
ESP004	Centro Nacional de Recursos Fitogenéticos	3	0.0%	99.8%	1	0	0
GRC102	Hellenic Mediterranean University	3	0.0%	99.8%	Not listed	0	0
LTU001	Lithuanian Institute of Agriculture	3	0.0%	99.8%	Not listed	0	3
POL003	Plant Breeding and Acclimatization Institute	3	0.0%	99.9%	3	0	0
UKR020	Institute of Forages	3	0.0%	99.9%	3	0	0
AUT025	Referat Pflanzengesundheit und Spezialkulturen	2	0.0%	99.9%	2	0	0
BDI003	Institut des Sciences Agronomiques du Burundi	2	0.0%	99.9%	Not listed	0	0
BGD014	Bangladesh Forest Research Institute (BFRI)	2	0.0%	99.9%	Not listed	0	0
BRA012	Embrapa Hortaliças	2	0.0%	99.9%	Not listed	0	0
CHL071	Banco de Germoplasma de Papa, Universidad Austral de Chile	2	0.0%	99.9%	2	0	0

ESP027	Gobierno de Aragón. Centro de Investigación y Tecnología Agroalimentaria. Banco de Germoplasma de Hortícolas	2	0.0%	99.9%	1	0	0
HRV041	Faculty of Agriculture, University of Zagreb	2	0.0%	99.9%	Not listed	0	0
UKR019	Research Station of Medicinal Crops	2	0.0%	99.9%	1	0	0
UKR075	Kolomyia Experimental Station	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
AZE003	Research Institute of Crop Husbandry	1	0.0%	99.9%	Not listed	0	0
AZE004	Institute of Botany	1	0.0%	100.0%	Not listed	0	0
AZE006	Research Institute of Forage, Meadows and Pastures	1	0.0%	100.0%	Not listed	0	0
BFA084	Commission nationale de gestion des ressources phytogenetiques	1	0.0%	100.0%	Not listed	0	0
CYP004	National (CYPARI) Genebank, Agricultural Research Institute, Ministry of Agriculture, Rural Development and Environment	1	0.0%	100.0%	1	0	0
ECU330	Estación Experimental Tropical Pichilingue	1	0.0%	100.0%	Not listed	0	0
EGY087	National Gene Bank	1	0.0%	100.0%	Not listed	0	0
ESP172	Cabildo Insular de Tenerife. Centro de Conservación de la Biodiversidad Agrícola de Tenerife	1	0.0%	100.0%	Not listed	0	0
GUY021	National Agricultural Research and Extension Institute	1	0.0%	100.0%	Not listed	0	0
LBY006	National Bank for Plant Genetic Resources	1	0.0%	100.0%	Not listed	0	0
PHL008	Bureau of Plant Industry, Department of Agriculture	1	0.0%	100.0%	Not listed	0	0
QAT004	Biotechnology Center, Ministry of Environment	1	0.0%	100.0%	1	1	1
TJK027	National Center for Genetic Resources	1	0.0%	100.0%	1	0	0
UKR017	Institute of Agriculture of the Woodlands	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)
Amaranthus hypochondriacus L.	9,157
Amaranthus L.	5,462
Amaranthus cruentus L.	3,773
Amaranthus caudatus L.	2,899
Amaranthus tricolor L.	1,225
Amaranthus hybridus L.	837
Amaranthus dubius Mart. ex Thell.	425
Amaranthus viridis L.	378
Amaranthus hybr.	340
Amaranthus spinosus L.	265
Amaranthus blitum L.	248
Amaranthus retroflexus L.	204
Amaranthus hybridus subsp. *quitensis* (Kunth) Costea & Carretero	124
Amaranthus graecizans L.	116
Amaranthus palmeri S. Watson	114
Amaranthus albus L.	70
Amaranthus blitum subsp. *oleraceus* (L.) Costea	62
Amaranthus tuberculatus (Moq.) J. D. Sauer	61
Amaranthus blitoides S. Watson	56
Amaranthus fimbriatus (Torr.) Benth. ex S. Watson	53
Amaranthus powellii S. Watson	43
Amaranthus thunbergii Moq.	20
Amaranthus deflexus L.	19
Amaranthus powellii subsp. *bouchonii* (Thell.) Costea & Carretero	15
Amaranthus watsonii Standl.	15
Amaranthus tortuosus Hornem.	12
Amaranthus graecizans subsp. silvestris (Tourn. ex Vill.) Brenan	9
Amaranthus pumilus Raf.	8
Amaranthus crispus (Lesp. & Thévenau) A. Braun ex J. M. Coult. & S. Watson	7
Amaranthus polygonoides L.	7
Amaranthus arenicola I. M. Johnst.	6
Amaranthus muricatus (Moq.) Hieron.	6
Amaranthus edulis Michx. ex Moq.	5
Amaranthus cannabinus (L.) Sauer	4
Amaranthus greggii S. Watson	4
Amaranthus wrightii S. Watson	4
Amaranthus australis (A. Gray) Sauer	3

Amaranthus blitum subsp. *emarginatus* (Salzm. ex Uline & W. L. Bray) Carretero, Muñoz Garm. & Pedrol	3
Amaranthus blitum var. *pseudogracilis* (Thell.) Lambinon	3
Amaranthus crassipes Schltdl.	3
Amaranthus interruptus R. Br.	3
Amaranthus praetermissus Brenan	3
Amaranthus standleyanus Parodi ex Covas	3
Amaranthus acanthochiton Sauer	2
Amaranthus californicus (Moq.) S. Watson	2
Amaranthus centralis J. Palmer & Mowatt	2
Amaranthus dinteri Schinz	2
Amaranthus floridanus (S. Watson) Sauer	2
Amaranthus hybridus subsp. *hybridus* x *hypochondriacus* L.	2
Amaranthus sparganicephalus Thell.	2
Amaranthus atropurpureus Roxb.	1
Amaranthus brownii Christoph. & Caum	1
Amaranthus cochleitepalus Domin	1
Amaranthus cuspidifolius Domin	1
Amaranthus grandiflorus (J. M. Black) J. M. Black	1
Amaranthus hybridus x *cruentus*	1
Amaranthus hypochondriacus x *retroflexus* L.	1
Amaranthus macrocarpus Benth.	1
Amaranthus polygamus L.	1
Amaranthus rubra K. Krause	1
Amaranthus tamaulipensis Henrickson	1
Amaranthus tenuifolius Willd.	1
Amaranthus tucsonensis Henrickson	1
Amaranthus x *ozanonii* Thell.	1
Amaranthus x *ozanonii* Priszter	1

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