GLOBAL CROP CONSERVATION AND USE METRICS

LETTUCE
(*Lactuca* L.)

CROP TRUST

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Suggested Citation
Khoury CK, Gora, S and Giovannini, P (2025) Global crop conservation and use metrics: Lettuce (*Lactuca* L.). 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

LETTUCE
(*Lactuca* L.)

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 lettuce 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 lettuce

Lettuce (*Lactuca sativa* L.) originated in the eastern Mediterranean region and western Asia, where it was likely domesticated from wild species in the Caucasus around 6,000 years ago. Ancient Egyptians, Greeks, and Romans cultivated it primarily for its oil-rich seeds before later selecting for leafy varieties (Cao *et al*., 2024; Wei et al., 2021). Today, lettuce is one of the most widely consumed leafy vegetables globally, valued primarily as a fresh salad green but also used in sandwiches, wraps, and cooked dishes, with major cultivar groups including crisphead/iceberg, butterhead, romaine, and loose-leaf types (Křístková *et al*., 2008; Mou, 2008). The crop has significant agricultural and economic importance as a major commercial vegetable, particularly in North America, Europe, and increasingly in Asia, while it provides dietary fiber, vitamins A and K, folate, and various antioxidants, though its nutritional contribution is modest compared to other leafy greens due to its comparatively high water content (Cao *et al*., 2024; Mou, 2008).

Based on the most recently available production statistics from FAOSTAT (which reports lettuce combined with chicory) for the year 2023, lettuce is cultivated in at least 105 countries on 1.3 million hectares worldwide, producing 28 million tonnes at a value of USD 16.3 billion (FAO, 2025a). The largest producers include China, USA, India, Spain, Italy, Türkiye, Japan, Mexico, and Belgium, each producing over 500,000 tonnes per annum.

There is considerable international trade in lettuce (around 2.5 million tonnes exported per annum), with Spain, Mexico, USA, China, Netherlands, and Italy reporting exporting over 100,000 tonnes each year (FAO, 2025a). Among the 163 countries reporting importing lettuce, the top recipients include USA, Canada, Germany, France, UK, and Italy, all importing over 100,000 tonnes each year.

Global consumption statistics are imprecise, with FAOSTAT reporting lettuce under its "Vegetables, Other" category (Khoury *et al.*, 2023). Estimates derived from these data for the years 2015-2018 indicate that lettuce is a major contributor to food weight in the food supplies of at least 129 countries (Table 1). Production and food supply metrics indicate that lettuce is widely utilized outside of its regions of origin, implying significant international interdependence with regard to crop genetic resources.

Table 1. Global status of lettuce production, trade, availability in food supplies, and public interest. Production, trade, and food supply statistics from FAOSTAT (2015 to 2018 average). Production and trade metrics are reported directly for lettuce (combined with chicory) in FAOSTAT; for food supply, lettuce 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, trade, or food supply. The evenness metric quantifies evenness of production, trade, or availability in food supplies across world regions, where 0 equals highly uneven and 1 equals completely even. The international interdependence metric quantifies degree of production, trade, 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)	1,277,923	24.50	0.17	0.87
Total production (tonnes)	28,081,136	36.00	0.15	0.86
Gross production value (current thousand USD)	11,349,176	39.75	0.21	0.71
Export quantity (tonnes)	2,241,100	17.00	0.20	0.35
Export value (current thousand USD)	2,578,543	24.25	0.18	0.35
Import quantity (tonnes)	2,168,249	47.50	0.22	0.38
Import value (current thousand USD)	2,712,624	55.25	0.19	0.36
Contribution to calories in food supplies (kcal/capita/day)	1.67	6.25	0.65	1.00
Contribution to protein in food supplies (g/capita/day)	0.09	45.00	0.63	1.00
Contribution to fat in food supplies (g/capita/day)	0.01	0.25	0.63	1.00
Contribution to food weight in food supplies (g/capita/day)	2.43	129.50	0.63	1.00
Number of public pageviews on Wikipedia over one year	8,239			

Identity and composition of *ex situ* collections

Based on the latest data in global genetic resource databases, germplasm collections of lettuce and its wild relatives (i.e., genus *Lactuca* L.) are present in at least 100 institutions worldwide, collectively maintaining 17,411 accessions (Table 2, Table 3; Supplementary Table 1). This is somewhat more than the number of accessions reported for the crop (16,298) 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 Europe as well as in the USA and Japan, with the largest collections in the USA (15.6% of total accessions worldwide) and the Netherlands (14.8%), as well as the UK, Czechia, Germany, Bulgaria, Spain, Hungary, and Japan; these 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 lettuce, the Center for Genetic Resources (CGN) (the Netherlands) as a global collection with an agreement dated 1989. This genebank currently maintains one of the largest lettuce collections worldwide, based on contemporary germplasm databases (Table 2).

Lactuca L. (Asteraceae) contains over 100 species, mainly native to temperate regions of Asia, Africa, and Europe, but also in North America and elsewhere (Lebeda *et al.*, 2019; WFO, 2025). The greatest species diversity is considered to be concentrated in southwest Asia and the Sino-Himalayan region (Lebeda *et al.*, 2019). A published genepool concept is available for lettuce (USDA, 2025).

The primary genepool contains:
Lactuca aculeata Boiss. & Kotschy
Lactuca altaica Fisch. & C. A. Mey.
Lactuca azerbaijanica Rech. f.
Lactuca dregeana DC.
Lactuca serriola L.

The secondary genepool contains:
Lactuca saligna L.

The tertiary genepool contains:
Lactuca acanthifolia (Willd.) Boiss.
Lactuca alpestris (Gand.) Rech. f.
Lactuca georgica Grossh.
Lactuca indica L.
Lactuca longidentata Moris ex DC.
Lactuca oblongifolia Nutt.
Lactuca orientalis (Boiss.) Boiss.
Lactuca quercina L. (and subspecies)
Lactuca reviersii Litard. & Maire
Lactuca scarioloides Boiss.
Lactuca sibirica (L.) Benth. ex Maxim.
Lactuca tatarica (L.) C. A. Mey.
Lactuca tetrantha B. L. Burtt & P. H. Davis
Lactuca viminea (L.) J. Presl & C. Presl (and subspecies)
Lactuca virosa L. (and subspecies)
Lactuca winkleri Kirp.

Data compilation for this report on lettuce genetic resources included all taxa in *Lactuca*. Along with the crop, 45 taxa as well as a few hybrids and accessions only recognized to the genus level are present in germplasm collections (Supplementary Table 2). These include large collections of the crop as well as *L. serriola*, *L. saligna*, *L. virosa*, and *Lactuca canadensis* L., and accessions only determined at the genus level.

Improved varieties make up the largest proportion of collections (41.5%), followed by landraces (20.8%), wild relatives (19.2%), and breeding materials (4.3%) (Table 3); these percentages are estimates based on available data, noting that 9.2% of accessions do not have biological status data and another 4.8% are marked as "other" materials. *Lactuca* germplasm has been collected from at least 91 countries, with approximately 33.3% of accessions originating from the primary region of diversity of the crop (i.e. Central and West Asia, Europe, and the Mediterranean); these statistics are also estimates, as 2.9% of lettuce landrace accessions and 9.9% 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 143 botanic gardens collectively conserve 53 *Lactuca* taxa; comparing these to genebank collections, 12 are present only in botanic gardens.

Aside from the taxa that appear to have limited representation in germplasm collections, the global genetic resources databases do not offer insights on diversity gaps, but published research has indicated specific priority species and geographic regions for further collecting for conservation. In a global *ex situ* conservation gap analysis of the wild relatives of major crops, Castañeda-Álvarez *et al.* (2016), assessing 15 lettuce wild relatives, listed eight (53.3%) as of high priority for further collecting, and one other species as of medium priority.

Table 2. Major *ex situ* collections of lettuce 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 (2024).

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)
USA022	Western Regional Plant Introduction Station, USDA-ARS, Washington State University	2,708	15.6%	15.6%	Not listed*	0	0
NLD037	Centre for Genetic Resources (CGN), the Netherlands	2,579	14.8%	30.4%	2,579	0	0
GBR006	Warwick Genetic Resources Unit	1,504	8.6%	39.0%	Not listed*	0	0
CZE122	Gene bank	1,414	8.1%	47.1%	1,270	80	1,414
DEU146	Genebank, Leibniz Institute of Plant Genetics and Crop Plant Research	1,164	6.7%	53.8%	1,156	0	0
USA974	Seed Savers Exchange	1,006	5.8%	59.6%	Not listed	0	0
BGR001	Institute for Plant Genetic Resources 'K.Malkov'	992	5.7%	65.3%	524	0	0
ESP027	Gobierno de Aragón. Centro de Investigación y Tecnología Agroalimentaria. Banco de Germoplasma de Hortícolas	854	4.9%	70.2%	815	0	0
HUN003	Centre for Plant Diversity	551	3.2%	73.4%	169	0	52
JPN183	NARO Genebank	437	2.5%	75.9%	50	0	0
POL003	Plant Breeding and Acclimatization Institute	417	2.4%	78.3%	417	0	0
ESP026	Generalidad Valenciana. Universidad Politécnica de Valencia. Escuela Técnica Superior de Ingenieros Agrónomos. Banco de Germoplasma	324	1.9%	80.1%	236	0	0
FRA011	Unité de Génétique et Amélioration des Fruits et Légumes, Plant Biology and Breeding, INRAE Avignon	300	1.7%	81.8%	Not listed	0	25
PRT001	Banco Português de Germoplasma Vegetal	234	1.3%	83.2%	40	0	0
SVN019	Crops and Seed Production Department, Agricultural Institute of Slovenia	192	1.1%	84.3%	192	0	135

ARG1350	Banco Activo de Germoplasma de La Consulta	190	1.1%	85.4%	Not listed	0	0
UKR008	Ustymivka Experimental Station of Plant Production	185	1.1%	86.4%	50	0	0
ESP004	Centro Nacional de Recursos Fitogenéticos	176	1.0%	87.5%	175	0	0
UKR021	Institute of Vegetable and Melon Growing	173	1.0%	88.4%	128	0	0
SWE054	Nordic Genetic Resource Center	166	0.9%	89.4%	166	0	0
	Other institutions (n = 80)	1,845	10.7%	100.0%	679	115	215

*confirmed by institution or otherwise known to store collections in long term conditions

Table 3. Composition of *ex situ* collections of lettuce 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	17,411	
Number of institutions holding genebank collections	100	
Number of distinct taxonomic names in genebank collections	50	
Number of accessions of crop wild relatives (CWR) in genebank collections	3,342	19.2%
Number of accessions of weedy materials in genebank collections	23	0.1%
Number of accessions of landraces in genebank collections	3,625	20.8%
Number of accessions of breeding materials in genebank collections	756	4.3%
Number of accessions of improved varieties in genebank collections	7,232	41.5%
Number of accessions of other materials in genebank collections	837	4.8%
Number of accessions not marked with an improvement type in genebank collections	1,596	9.2%
Number of countries where germplasm has been collected for genebank collections	91	
Number of accessions in genebank collections from the primary region(s) of diversity	5,799	33.3%
Number of taxa in botanic garden collections	53	
Number of botanic gardens holding collections of crop or its wild relatives	143	

Multilateral System status of accessions in *ex situ* collections

The genus *Lactuca* 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 17,411 accessions conserved globally, approximately 0.4% are held in international institutions (i.e., the World Vegetable Center), and are included in the MLS of the Plant Treaty, with the remainder maintained in national and other collections (Table 4).

As of 2025, 195 accessions are formally included in the MLS according to the Plant Treaty's GLIS database, and 4,740 accessions have been assigned Digital Object Identifiers (DOIs). Per the relevant fields in the global genetic resources databases, 1,841 accessions (10.6% of world total) are listed as included in the MLS; this may be an underestimate, noting that 44% of accessions do not have MLS status data.

Table 4. Representation of lettuce 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	86	0.5%
Number of accessions in genebank collections in national or other institutions	17,325	99.5%
Number of accessions in genebank collections in Annex I	0	0%
Number of accessions with DOI (Plant Treaty GLIS 2025)	4,740	
Number of accessions included in the Multilateral System (MLS) (Plant Treaty GLIS 2025)	195	
Number of accessions included in the Multilateral System (MLS) (genebank collections databases)	1,841	10.6%
Number of accessions included in the Multilateral System (MLS) that are in international collections (genebank collections databases)	63	0.4%
Number of accessions not included in the Multilateral System (MLS) (genebank collections databases)	7,905	45.4%
Number of accessions without information regarding inclusion in the Multilateral System (MLS) (genebank collections databases)	7,665	44.0%

Storage conditions, regeneration status, and safety duplication

As expected for an orthodox seed crop, the great majority (at least 93.8%) of *Lactuca* accessions are conserved as seed, with 53% of these accessions listed as conserved under long-term cold-storage conditions and a substantial proportion of additional accessions also likely conserved in long-term conditions even though they are not reported as such in global germplasm databases (Table 2, Table 5). Information on storage in general is missing for 6.2% of all accessions, and information on seed storage type (i.e., long, medium, or short term) is missing for 32% 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 366 *Lactuca* accessions regenerated during this time by reporting institutions, with 1,015 accessions identified as needing regeneration and 973 of these lacking funds to conduct the regeneration.

Analysis of the location of safety duplication sites of lettuce germplasm, as listed in Genesys, indicates that at least 23% of accessions are safety duplicated in an active collection (i.e., apart frtom 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 lettuce 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 28.4% of total accessions worldwide are duplicated in Svalbard.

Table 5. Storage conditions of lettuce *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	16,322	93.8%
Number of accessions held in short-term seed storage in genebank collections	6	0.0%
Number of accessions held in medium-term seed storage in genebank collections	2,450	15.0%
Number of accessions held in long-term seed storage in genebank collections	8,646	53.0%
Number of accessions held in seed storage of undefined type in genebank collections	5,220	32.0%
Number of accessions held in field storage in genebank collections	10	0.1%
Number of accessions held in *in vitro* storage in genebank collections	0	0.0%
Number of accessions held in cryo storage in genebank collections	8	0.0%
Number of accessions held as DNA in genebank collections	2	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	1,079	6.2%
Number of accessions in genebank collections regenerated 2014–2019	366	29.5%
Number of accessions in genebank collections in need of regeneration 2014–2019	1,015	81.9%
Number of accessions in genebank collections in need of regeneration without budget for regeneration 2014–2019	973	78.5%
Number of accessions safety duplicated out of the country in genebank collections	3,668	23.0%
Number of accessions in genebank collections safety duplicated in Svalbard	4,947	28.4%

Documentation, information systems, and research resources

The World Vegetable Center published a descriptor list for lettuce in 2015 (WorldVeg, 2015). Descriptors have also been proposed in the scientific literature (Křístková *et al.*, 2008) and implemented by specific national collections such as those at USDA (USDA, 2025a).

The estimated completeness of passport information for *Lactuca* accessions listed in Genesys is 6.5 on a scale of 0 (no data) to 10 (complete data), which indicates that a sizable amount of data is available, but also that there are gaps that it would be valuable to fill. Four metrics of the current degree of digital sequence information (DSI) for lettuce (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. Lettuce, along with tomatoes, onions and garlic, and beets, stand out compared to many other vegetables in terms of the degree of DSI resources, published literature, and research resources in GBIF (Khoury *et al.*, 2023).

Table 6. Documentation, information systems, and research resources for lettuce. 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	6.5
Number of genes as recorded in NCBI's Entrez database as of 2022	55,804
Number of genomes as recorded in NCBI's Entrez database as of 2022	1
Number of nucleotides as recorded in NCBI's Entrez database as of 2022	231,891
Number of proteins as recorded in NCBI's Entrez database as of 2022	134,765
Number of publications listed in Google Scholar with taxon name in title published between 2009 and 2019	3,570
Number of publications listed in PubMed Central with taxon name in text as of 2022	24,339
Number of research materials as recorded in GBIF (2025)	1,024,043

Germplasm distributions and varietal registrations and releases

Germplasm distributions and varietal development statistics for lettuce 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). Lettuce is among the most distributed vegetable crops in both these datasets (Khoury *et al*., 2023) (Table 7). Distributions as reported in the FAO WIEWS dataset were made from institutions in 13 countries, with the largest numbers of samples distributed from institutions in the Netherlands, Spain, Romania, Sweden, and France, and were primarily to within-country national agricultural research centers, to farmers or non-governmental organizations (NGOs), and to other

(unspecified) users (Khoury *et al.*, 2025). In the Plant Treaty dataset, the providers of the most samples were located in the Netherlands, Spain, and China, and the recipients of the most samples were located in the Netherlands, France, Spain, USA, China, Japan, and the UK.

Information on varietal registrations and releases indicate that lettuce is also among those vegetables with the largest numbers of varieties in development.

Table 7. Lettuce 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	519.1
Average annual number of samples distributed worldwide as recorded in FAO WIEWS	1,447.5
Average annual number of samples distributed worldwide as recorded in the Plant Treaty Data Store	1,527.3
Number of countries receiving germplasm as recorded in the Plant Treaty Data Store	9.6
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	915.5
Average annual number of varietal releases worldwide as recorded in FAO WIEWS	241.8

Networks and partnerships

Currently active networks include:

- The European Cooperative Programme for Plant Genetic Resources (ECPGR) Leafy Vegetables Working Group
- The European Union-funded Crop Wild Relatives Utilization and Conservation for Sustainable Agriculture (COUSIN) project unites 12 European countries to conduct *in situ* and *ex situ* conservation for wild relatives of lettuce.
- The USDA ARS Leafy Vegetable Crop Germplasm Committee (also here)
- PGR Lettuce
- Communities related to lettuce genetics and genomics, e.g. Guo *et al.* (2022) and Zhou *et al.* (2024)

Conclusions

Lettuce continues to be a very important vegetable crop globally. Its genetic resources are bolstered by the activities taking place in collections in national and subnational agricultural research organizations; there are no major international collections for the crop. 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 10.6% 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 and varietal development for the crop. Further efforts are required to: 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.

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

Cao S, Sawettalake N, Li P, Fan S, and Shen L (2024) DNA methylation variations underlie lettuce domestication and divergence. *Genome Biology* 25(1): 158. https://doi.org/10.1186/s13059-024-03310-x

Castañeda-Álvarez NP, Khoury CK, Achicanoy HA, Bernau V, Dempewolf H, Eastwood RJ, Guarino L, Harker RH, Jarvis A, Maxted N, Mueller JV, Ramírez-Villegas J, Sosa CC, Struik PC, Vincent H, and Toll J (2016) Global conservation priorities for crop wild relatives. *Nature Plants* 2(4): 16022. https://doi.org/10.1038/nplants.2016.22

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

Guo Z, Li B, Du J, Shen F, Zhao Y, Deng Y, *et al.* (2023) LettuceGDB: The community database for lettuce genetics and omics. *Plant Communications* 4(1): 100425. https://doi.org/10.1016/j.xplc.2022.100425

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

Křístková E, Doležalová I, Lebeda A, Vinter V, and Novotná A (2008) Description of morphological characters of lettuce (*Lactuca sativa* L.) genetic resources. *Hortic Sci.* 35(3): 113–129. https://doi.org/10.17221/4/2008-HORTSCI

Lebeda, Křístková E, Kitner M, Majeski L, Doležalová I, Khoury CK, *et al.* (2019) Research Gaps and Challenges in the Conservation and Use of North American Wild Lettuce Germplasm. *Crop Science* 59(6): 2337–2356. https://doi.org/10.2135/cropsci2019.05.0350

Mou B (2008) Lettuce. In: Prohens J and Nuez F, eds. *Vegetables I*. Springer New York; pp 75–116. https://doi.org/10.1007/978-0-387-30443-4_3

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 (2025a) Amaranth Descriptor. https://npgsweb.ars-grin.gov/gringlobal/cropdetail?type=descriptor&id=159 (accessed October 2025)

USDA (2025b) 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

Wei T, van Treuren R, Liu X, Zhang Z, Chen J, Liu Y, *et al.* (2021) Whole-genome resequencing of 445 *Lactuca* accessions reveals the domestication history of cultivated lettuce. *Nat Genetics* 53(5): 752–760. https://doi.org/10.1038/s41588-021-00831-0

World Flora Online (WFO) (2025) *Lactuca* L. http://www.worldfloraonline.org/taxon/wfo-4000020393 (accessed October 2025)

World Vegetable Center (WorldVeg) (2015) World Vegetable Center Genebank morphological descriptors. https://worldveg.tind.io/record/75880/?v=pdf (accessed November 2025)

Zhou W, Yang T, Zeng L, Chen J, Wang Y, Guo X, *et al.* (2024) LettuceDB: an integrated multi-omics database for cultivated lettuce. *Database* 2024: baae018. https://doi.org/10.1093/database/baae018

Supplementary information

Supplementary Table 1: Full list of *ex situ* collections of lettuce 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)
USA022	Western Regional Plant Introduction Station, USDA-ARS, Washington State University	2,708	15.6%	15.6%	Not listed	0	0
NLD037	Centre for Genetic Resources, the Netherlands	2,579	14.8%	30.4%	2,579	0	0
GBR006	Warwick Genetic Resources Unit	1,504	8.6%	39.0%	Not listed	0	0
CZE122	Gene bank	1,414	8.1%	47.1%	1,270	80	1,414
DEU146	Genebank, Leibniz Institute of Plant Genetics and Crop Plant Research	1,164	6.7%	53.8%	1,156	0	0
USA974	Seed Savers Exchange	1,006	5.8%	59.6%	Not listed	0	0
BGR001	Institute for Plant Genetic Resources 'K.Malkov'	992	5.7%	65.3%	524	0	0
ESP027	Gobierno de Aragón. Centro de Investigación y Tecnología Agroalimentaria. Banco de Germoplasma de Hortícolas	854	4.9%	70.2%	815	0	0
HUN003	Centre for Plant Diversity	551	3.2%	73.4%	169	0	52
JPN183	NARO Genebank	437	2.5%	75.9%	50	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)
POL003	Plant Breeding and Acclimatization Institute	417	2.4%	78.3%	417	0	0
ESP026	Generalidad Valenciana. Universidad Politécnica de Valencia. Escuela Técnica Superior de Ingenieros Agrónomos. Banco de Germoplasma	324	1.9%	80.1%	236	0	0
FRA011	Unité de Génétique et Amélioration des Fruits et Légumes, Plant Biology and Breeding, INRAE Avignon	300	1.7%	81.8%	Not listed	0	25
PRT001	Banco Português de Germoplasma Vegetal	234	1.3%	83.2%	40	0	0
SVN019	Crops and Seed Production Department, Agricultural Institute of Slovenia	192	1.1%	84.3%	192	0	135
ARG1350	Banco Activo de Germoplasma de La Consulta	190	1.1%	85.4%	Not listed	0	0
UKR008	Ustymivka Experimental Station of Plant Production	185	1.1%	86.4%	50	0	0
ESP004	Centro Nacional de Recursos Fitogenéticos	176	1.0%	87.5%	175	0	0
UKR021	Institute of Vegetable and Melon Growing	173	1.0%	88.4%	128	0	0
SWE054	Nordic Genetic Resource Center	166	0.9%	89.4%	166	0	0
CYP004	National (CYPARI) Genebank, Agricultural Research Institute, Ministry of Agriculture, Rural Development and Environment	158	0.9%	90.3%	156	0	0
ROM007	Suceava Genebank	156	0.9%	91.2%	53	52	52
BRA012	Embrapa Hortaliças	111	0.6%	91.8%	Not listed	0	0
GBR004	Millennium Seed Bank - Royal Botanic Gardens Kew	110	0.6%	92.5%	Not listed	0	0
MNG030	Institute of Plant and Agricultural Science	110	0.6%	93.1%	9	0	0
ISR002	Israel Gene Bank for Agricultural Crops, Agricultural Research Organisation, Volcani Center	104	0.6%	93.7%	38	0	0
KGZ040	Bank-Laboratory of Plant Genetic Resources of the KR	104	0.6%	94.3%	5	0	0
CHL177	Banco Activo INIA La Platina	93	0.5%	94.8%	Not listed	0	0
TUR001	Plant Genetic Resources Department	81	0.5%	95.3%	81	0	0
TWN001	World Vegetable Center	81	0.5%	95.8%	79	62	63

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)
HRV044	College of Agriculture at Križevci	51	0.3%	96.1%	20	0	0
UZB006	Uzbek Research Institute of Plant Industry	47	0.3%	96.3%	Not listed	0	0
VNM049	Plant Resources Center	47	0.3%	96.6%	Not listed	0	0
CHE001	Agroscope Changins	46	0.3%	96.9%	30	0	46
ALB026	Plant Genetic Resources Center	43	0.2%	97.1%	43	0	0
UKR075	Kolomyia Experimental Station	43	0.2%	97.4%	1	0	0
GRC005	Greek Genebank, Institute of Plant Breeding and Genetic Resources	34	0.2%	97.6%	Not listed	0	0
TJK027	National Center for Genetic Resources	33	0.2%	97.7%	32	0	0
MAR088	Centre Régional de la Recherche Agronomique de Settat	31	0.2%	97.9%	4	0	0
EGY087	National Gene Bank	26	0.1%	98.1%	Not listed	0	0
IND001	National Bureau of Plant Genetic Resources	26	0.1%	98.2%	26	0	0
ARM059	Agrobiotechnology Scientific Center	24	0.1%	98.4%	Not listed	0	13
BRA003	Embrapa Recursos Genéticos e Biotecnologia	22	0.1%	98.5%	Not listed	0	0
GBR017	Henry Doubleday Research Association	22	0.1%	98.6%	Not listed	0	0
AUT047	HBLFA Gartenbau Schönbrunn	16	0.1%	98.7%	16	0	0
CAN004	Plant Gene Resources of Canada, Saskatoon Research and Development Centre	15	0.1%	98.8%	15	0	15
ITA363	Dipartimento di Chimica, Biologia e Biotecnologie, Universitá degli Studi Perugia	13	0.1%	98.9%	13	0	0
LBY006	National Bank for Plant Genetic Resources	12	0.1%	98.9%	Not listed	0	0
PAK001	Plant Genetic Resources Program	12	0.1%	99.0%	2	0	2
BIH039	Institute of Genetic Resources, University of Banja Luka	10	0.1%	99.1%	10	0	0
SAU015	Plant Genetic Resources Bank	9	0.0%	99.1%	Not listed	0	9
CUB014	Instituto de Investigaciones Fundamentales en Agricultura Tropical	8	0.0%	99.2%	Not listed	0	0
GHA091	Plant Genetic Resources Research Institute	8	0.0%	99.2%	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)
GRC044	Balkan Botanic Garden of Kroussia, Institute of Plant Breeding and Genetic Resources	8	0.0%	99.2%	Not listed	0	0
JOR105	National Agricultural Research Center	7	0.0%	99.3%	Not listed	0	0
AUT025	Referat Pflanzengesundheit und Spezialkulturen	6	0.0%	99.3%	6	0	0
LBN020	Lebanese Agricultural Research Institute	6	0.0%	99.4%	6	0	0
PRT102	Banco de Germoplasma - Universidade da Madeira	6	0.0%	99.4%	Not listed	0	6
BEL002	Gembloux agro-biotech, Université de Liège, département des Sciences agronomiques, Phytotechnie tropicale et Horticulture	5	0.0%	99.4%	Not listed	0	5
DEU502	Botanical Garden of the University of Osnabrück	5	0.0%	99.4%	Not listed	0	0
GRC100	CIHEAM Mediterranean Agronomic Institute of Chania	5	0.0%	99.5%	5	0	0
HRV045	Faculty of Agrobiotechnical Sciences Osijek, University J.J. Strossmayer in Osijek	5	0.0%	99.5%	Not listed	0	0
MKD001	Faculty of Agriculture, University Ss. Cyril and Methodius	5	0.0%	99.5%	Not listed	0	0
MKD007	Fabia CSB Bogdanci	5	0.0%	99.6%	Not listed	0	0
UKR081	Experimental Station 'Maiak'	5	0.0%	99.6%	4	0	0
ARG1408	Instituto de Investigación y Desarrollo Hortícola Semillero	4	0.0%	99.6%	Not listed	0	0
ARM005	Institute of Botany	4	0.0%	99.6%	Not listed	0	0
AZE015	Genetic Resources Institute	4	0.0%	99.7%	Not listed	0	0
ARM008	Scientific Centre of Vegetable and Industrial Crops	3	0.0%	99.7%	Not listed	0	3
BLR014	State research institution 'Institute of Experimental Botany of the National Academy of Sciences of Belarus'	3	0.0%	99.7%	3	0	0
ESP003	Comunidad de Madrid. Universidad Politécnica de Madrid. Escuela Técnica Superior de Ingeniería Agronómica, Alimentaria y de Biosistemas . Banco de Germoplasma César Gómez Campo	3	0.0%	99.7%	3	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)
ESP200	Govern de les Illes Balears. Conselleria de Presidència. Direcció General d'Agricultura i Desenvolupament Rural. Institut de recerca i formació agrària i pesquera	3	0.0%	99.7%	Not listed	0	0
GUY021	National Agricultural Research and Extension Institute	3	0.0%	99.7%	Not listed	0	0
ITA368	Banca del germoplasma autoctono vegetale regionale	3	0.0%	99.8%	3	0	0
ROM055	Research and Development Station for Vegetables - Bacau	3	0.0%	99.8%	Not listed	0	0
SVK001	National Agricultural and Food Centre (NPPC), Research Institute of Plant Production (RIPP)	3	0.0%	99.8%	Not listed	0	0
TUR034	Field Crop Central Research Institute	3	0.0%	99.8%	3	0	0
ZMB030	SADC Plant Genetic Resources Centre	3	0.0%	99.8%	3	0	0
ALB037	National Agency of Protected Areas	2	0.0%	99.8%	Not listed	0	0
BGD028	Bangladesh Institute of Nuclear Agriculture (BINA)	2	0.0%	99.9%	Not listed	0	0
GRC102	Hellenic Mediterranean University	2	0.0%	99.9%	Not listed	0	0
KEN212	Genetic Resources Research Institute	2	0.0%	99.9%	2	0	0
LBN002	International Centre for Agricultural Research in Dry Areas	2	0.0%	99.9%	Not listed	0	0
NZL001	Margot Forde Genebank, AgResearch Ltd	2	0.0%	99.9%	Not listed	0	0
TUN029	Banque Nationale de Gènes de Tunisie	2	0.0%	99.9%	2	0	0
AUT001	Austrian Agency for Health and Food Safety	1	0.0%	99.9%	1	0	0
BLR011	Republican Unitary Enterprise 'Research and Practical Centre of the National Academy of Sciences of Belarus for Arable Farming'	1	0.0%	99.9%	Not listed	0	0
BRA008	Embrapa Arroz e Feijão	1	0.0%	99.9%	Not listed	0	0
CHL028	Banco Base de Semillas INIA Intihuasi	1	0.0%	99.9%	1	0	0
CUB251	Instituto de Investigaciones Agropecuarias Jorge Dimitrov	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)
DEU022	Botanical Garden Berlin-Dahlem	1	0.0%	99.9%	Not listed	0	0
ESP133	Región de Murcia. Instituto Murciano de Investigación y Desarrollo Agrario y Alimentario. Fruticultura	1	0.0%	100.0%	1	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
ETH085	Ethiopian Biodiversity Institute	1	0.0%	100.0%	Not listed	0	0
LVA009	Latvian State Forest Research Institute 'Silava'	1	0.0%	100.0%	1	0	0
MMR015	Myanmar SeedBank	1	0.0%	100.0%	Not listed	0	0
QAT004	Biotechnology Center, Ministry of Environment	1	0.0%	100.0%	1	1	1
ROM077	Research and Development Station for Vegetables - Iernut	1	0.0%	100.0%	Not listed	0	0
UKR023	Donets'k Experimental Station	1	0.0%	100.0%	Not listed	0	0
UKR135	Uman' Agrarian Academy	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)
Lactuca sativa L.	13,491
Lactuca serriola L.	2,392
Lactuca saligna L.	380
Lactuca virosa L.	342
Lactuca canadensis L.	239
Lactuca L.	130
Lactuca georgica Grossh.	78
Lactuca tatarica (L.) C. A. Mey.	47
Lactuca perennis L.	44
Lactuca sativa x *serriola*	41
Lactuca viminea (L.) J. Presl & C. Presl	31
Lactuca indica L.	27
Lactuca aculeata Boiss. & Kotschy	24
Lactuca floridana (L.) Gaertn.	12
Lactuca tuberosa Jacq.	12

Lactuca biennis (Moench) Fernald	11
Lactuca orientalis (Boiss.) Boiss.	11
Lactuca quercina L.	11
Lactuca hybr.	8
Lactuca tenerrima Pourr.	8
Lactuca quercina subsp. *wilhelmsiana* (Fisch & C. A. Mey. ex DC.) Feráková	7
Lactuca inermis Forssk.	6
Lactuca tetrantha B. L. Burtt & P. H. Davis	6
Lactuca undulata Ledeb.	6
Lactuca muralis (L.) E. Mey.	5
Lactuca bourgaei (Boiss.) Irish & N. Taylor bis	3
Lactuca homblei De Wild.	3
Lactuca ludoviciana (Nutt.) Riddell	3
Lactuca quercina subsp. *quercina* L.	3
Lactuca sagittata Schur	3
Lactuca alaica Kovalevsk.	2
Lactuca alpestris (Gand.) Rech. f.	2
Lactuca intricata Boiss.	2
Lactuca macrophylla (Willd.) A. Gray	2
Lactuca palmensis Bolle	2
Lactuca raddeana Maxim.	2
Lactuca sibirica (L.) Benth. & Hook. f. ex Maxim.	2
Lactuca alpina Benth. & Hook. f.	1
Lactuca aurea (Sch. Bip.) Stebbins	1
Lactuca brachyrrhyncha Greenm.	1
Lactuca deltoidea (M. Bieb.) C. A. Mey.	1
Lactuca dissecta D. Don	1
Lactuca glandulifera Hook. f.	1
Lactuca imbricata Hiern	1
Lactuca lasiorhiza (O. Hoffm.) C. Jeffrey	1
Lactuca oblongifolia Nutt.	1
Lactuca plumieri (L.) Gren. & Godr.	1
Lactuca sativa x *seriola*	1
Lactuca viminea subsp. *chondrilliflora* (Boreau) Bonnier	1
Lactuca viminea subsp. *viminea* (L.) J. Presl & C. Presl	1

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