GLOBAL CROP CONSERVATION AND USE METRICS

OATS
(*Avena* L.)

CROP TRUST

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Global crop conservation and use metrics

OATS
(*Avena* L.)

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Description

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

- 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; and
- varietal registrations and releases.

The report also includes global statistics on crop production, trade, and availability in food supplies, as well as information about crop networks and partnerships. It is meant to provide an update to some of the information presented in the Global Conservation Strategy for oats (Crop Trust, 2008), but is primarily based on publicly available datasets, rather than a new survey of genetic resource collections and expert consultations.

Introduction and background on oats

Oat (*Avena sativa* L.) is a cereal grain that originated in the Fertile Crescent of the Near East, where it initially grew as a weed among other cultivated crops, like wheat and barley, before being domesticated around 3,000 years ago (Sun *et al.*, 2022). As cultivation spread northward into the cooler, wetter climates of northern Europe, oats became increasingly important because they were productive in conditions where other cereals struggled. Today, oats are grown worldwide for animal feed, human consumption, and industrial applications. As a human food, oats are valued for their nutritional benefits, particularly their high content of beta-glucan soluble fiber, which has been shown to reduce cholesterol levels and improve heart health (Othman *et al.*, 2011). Rolled oats, steel-cut oats, and oatmeal are popular breakfast foods, while oat flour is used in baking. The grain is also processed into oat milk, a plant-based dairy alternative that has gained significant popularity in recent years (Holopainen-Mantila *et al.*, 2024). Beyond food, oats are used in cosmetics and skincare products due to their soothing and moisturizing properties. The agricultural importance of the crop stems from its ability to improve soil health, require fewer pesticides than many other cereal crops, and serve as a rotation crop that helps break pest and disease cycles in farming systems (Marshall *et al.*, 2013).

Based on the most recently available production statistics from FAOSTAT, reporting for the year 2023, oats are cultivated in at least 75 countries on over eight million total hectares worldwide, producing 18.8 million tonnes of grain at a value of over USD 3.8 billion (FAO, 2025a). The largest producers include the Russian Federation, Canada, Poland, Finland, Australia, Brazil, UK, USA, and China, each producing over 600,000 tonnes per annum.

There is considerable international trade in oats (over 4 million tonnes per annum), with Canada, Australia, Finland, Sweden, Russian Federation, UK, Poland, France, and Lithuania all reporting exporting over 100,000 tonnes each year (FAO, 2025a). Among the 145 countries reporting importing oats, the top recipients include USA, Germany, China, Netherlands, Spain, and Belgium, all importing over 100,000 tonnes each year.

Oats are a major contributor to calories in the food supplies of 58 countries and to protein in 70 countries (Table 1). Production, trade, and food supply metrics all indicate that oats are widely utilized outside of their regions of origin, implying significant international interdependence with regard to genetic resources.

Table 1. Global status of oat production, trade, availability in food supplies, and public interest. Production, trade, and food supply statistics from FAOSTAT (2015 to 2018 average). 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)	9,670,756	50.25	0.26	0.62
Total production (tonnes)	23,440,911	32.50	0.28	0.61
Gross production value (current thousand USD)	3,487,384	24.50	0.33	0.65
Export quantity (tonnes)	3,756,651	18.25	0.15	0.65
Export value (current thousand USD)	1,301,344	17.75	0.20	0.66
Import quantity (tonnes)	4,254,569	40.00	0.24	0.77
Import value (current thousand USD)	1,506,002	43.25	0.31	0.80
Contribution to calories in food supplies (kcal/capita/day)	4.00	58.50	0.41	0.86
Contribution to protein in food supplies (g/capita/day)	0.14	70.75	0.41	0.87
Contribution to fat in food supplies (g/capita/day)	0.06	40.75	0.42	0.85
Contribution to food weight in food supplies (g/capita/day)	0.64	49.25	0.38	0.88
Number of public pageviews on Wikipedia over one year	4311			

Identity and composition of *ex situ* collections

Based on the latest data in global genetic resource databases, oat and wild relatives (i.e., genus *Avena* L.) germplasm collections are present in at least 104 institutions worldwide, collectively maintaining 115,605 accessions (Table 2, Table 3; Supplementary Table 1). This is slightly more than the number of accessions reported for the crop (115,596) 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 well distributed globally, including large collections in the Americas, Europe, Australia, Asia, and Africa. Oat is not a mandate crop of the international agricultural research centres of the CGIAR. The Plant Gene Resources of Canada (PGRC), USDA-ARS National Small Grains Collection (USA), and the N.I. Vavilov All-Russian Research Institute of Plant Industry (VIR) (Russian Federation) collectively maintain over half of documented accessions worldwide. Reported information on the status of accessions under the Multilateral System of Access and Benefit Sharing (MLS) of the International Treaty on Plant Genetic Resources for Food and Agriculture (Plant Treaty), as recorded in the Global Information System (GLIS) and in pertinent fields in Genesys and FAO WIEWS (Table 2; Table 4), likely underestimate the full degree to which accessions are currently included in the MLS, as several of the oat collections without information on MLS status are in countries that are contracting parties to the Plant Treaty (such as USA, Bulgaria, and the UK) and distribute samples using the Standard Material Transfer Agreement (SMTA).

Table 2. Major *ex situ* collections of oat genetic resources. Top 20 institutions listed in descending order of total number of accessions. Number of accessions and storage condition information from Genesys and FAO WIEWS (2024), 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)
CAN004	Plant Gene Resources of Canada (PGRC), Saskatoon Research and Development Centre	28,514	24.7%	24.7%	28,514	0	28,514
USA029	National Small Grains Collection, USDA-ARS	20,797	18.0%	42.7%	20,780	0	0
RUS001	N.I. Vavilov All-Russian Research Institute of Plant Industry (VIR)	10,445	9.0%	51.7%	10,445	0	0
AUS165	Australian Grains Genebank, Agriculture Victoria	5,095	4.4%	56.1%	Not listed*	4,885	4,252
DEU146	Genebank, Leibniz Institute of Plant Genetics and Crop Plant Research (IPK)	4,858	4.2%	60.3%	4,844	4,856	4,858
KEN212	Genetic Resources Research Institute	4,197	3.6%	63.9%	4,197	760	4,197
GBR016	Genetic Resources Unit, Institute of Biological, Environmental & Rural Sciences, Aberystwyth University	2,781	2.4%	66.3%	Not listed	0	21
POL003	Plant Breeding and Acclimatization Institute	2,676	2.3%	68.7%	2,663	0	2,256
BGR001	Institute for Plant Genetic Resources 'K.Malkov'	2,672	2.3%	71.0%	1,958	0	0
GBR247	Germplasm Resources Unit, John Innes Centre, Norwich Research Park	2,640	2.3%	73.3%	2,640	0	0
MAR088	Centre Régional de la Recherche Agronomique de Settat	2,422	2.1%	75.3%	Not listed	0	0
CZE122	Gene bank	2,204	1.9%	77.3%	2,204	97	2,204
ESP004	Centro Nacional de Recursos Fitogenéticos	1,709	1.5%	78.7%	1,680	0	1,306
ISR003	Lieberman Germplasm Bank, Institute for Cereal Crops Improvement, Tel-Aviv University	1,592	1.4%	80.1%	Not listed	0	0
JPN183	NARO Genebank	1,444	1.3%	81.4%	292	781	781
MNG030	Institute of Plant and Agricultural Science	1,429	1.2%	82.6%	6	0	3

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 (NBPGR)	1,395	1.2%	83.8%	1,395	0	0
HUN003	Centre for Plant Diversity	1,343	1.2%	85.0%	424	0	42
SVK003	Breeding Research Station	1,008	0.9%	85.8%	15	0	1,008
SWE054	Nordic Genetic Resource Center	997	0.9%	86.7%	997	1,738	997
	Other institutions (n = 84)	15,387	13.3%	100%	8,392	2,326	6,032

*But documented in the 2008 Strategy as maintaining collections in long-term conditions (Crop Trust, 2008).

The 2008 Strategy process identified a similar list of major collections for oats (Crop Trust, 2008), although several collections listed in the Strategy are not currently reported in global genetic resource databases, including the Institute of Crop Germplasm Resources (CAAS) (China, 3,257 accessions). The Strategy described many unique collections for the crop, both in terms of landraces and wild relatives.

Avena L. (Poaceae) contains approximately 34 species (USDA, 2025), including the major cultivated species (*A. sativa*) and several species cultivated to a minor degree for food or fodder at the regional level, including *Avena abyssinica* Hochst. ex A. Rich. (Ethiopia and Eritrea), *Avena byzantina* K. Koch (syn. *A. sativa*) (Mediterranean and Middle East), *Avena nuda* L. (Europe), and *Avena strigosa* Schreb. (Europe), as well as wild taxa. Native distributions are in Europe, Asia, and North Africa, with some species naturalized in other regions.

Genepool assignments for cultivated oats (*A. sativa*) include five species in the primary genepool:
Avena fatua L.
Avena hybrida Peterm.
Avena occidentalis Durieu
Avena sterilis L., and
Avena trichophylla K. Koch)

Four species are included in the secondary genepool:
Avena agadiriana B. R. Baum & Fedak
Avena insularis Ladiz.
Avena magna H. C. Murphy & Terrell, and
Avena murphyi Ladiz.

The remaining ca. 22 species in the genus are in the tertiary genepool (USDA, 2025).

Data compilation for this report on oat genetic resources included all species in *Avena*. Along with the crop (*A. sativa*), 31 taxa as well as hybrids and accessions only recognized to the genus level are present in germplasm collections (Supplementary Table 2). These include large collections of *A. sterilis, Avena barbata* Pott ex Link, *A. fatua, A. byzantina, A. strigosa,* and *A. magna,* each with over 1000 accessions conserved worldwide. Wild relatives make up the largest proportion of collections (27.7%), followed by improved varieties (20.5%), breeding materials (17.8%), and landraces (8.1%) (Table 3); these percentages are estimates based on available data, noting that 25.7% of accessions do not have biological status data.

Table 3. Composition of *ex situ* collections of oat genetic resources. Main *ex situ* collections data from Genesys and FAO WIEWS (2024). Primary and secondary regions information from Khoury *et al*. (2023) and subsequent research for this summary. Botanic gardens data from BGCI PlantSearch (2024).

Metric	Number	Percentage
Total number of accessions in genebank collections	115,605	
Number of institutions holding genebank collections	104	
Number of distinct taxonomic names in genebank collections	35	
Number of accessions of crop wild relatives (CWR) in genebank collections	32,065	27.7%
Number of accessions of weedy materials in genebank collections	167	0.1%
Number of accessions of landraces in genebank collections	9,368	8.1%
Number of accessions of breeding materials in genebank collections	20,593	17.8%
Number of accessions of improved varieties in genebank collections	23,648	20.5%
Number of accessions of other materials in genebank collections	1	0%
Number of accessions not marked with an improvement type in genebank collections	29,759	25.7%
Number of countries where germplasm has been collected for genebank collections	92	
Number of accessions in genebank collections from the primary region(s) of diversity	2,744	2.4%
Number of accessions in genebank collections from the primary and secondary region(s) of diversity	34,614	29.9%
Number of taxa in botanic garden collections	30	
Number of botanic gardens holding collections of crop or its wild relatives	92	

Avena germplasm has been collected from at least 92 countries, with approximately 2.4% of accessions originating from the primary region of diversity of the crop (i.e. Northern Europe) and 29.9% from primary and secondary (i.e. Southwestern Europe, the Mediterranean, South Asia, and North America) regions; these statistics are also estimates, as 9.6% of oat landrace accessions and 2.4% 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 92 botanic gardens collectively conserve 30 *Avena* taxa. All of these taxa are also conserved in genebank 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. Gaps for several wild *Avena* species were noted in the Strategy, and the stakeholder meeting identified specific landrace types as gaps in existing collections, for example Central Asian hull-less cultivars (Crop Trust, 2008).

In a global *ex situ* conservation gap analysis of the wild relatives of major crops, Castañeda-Álvarez *et al.* (2016), assessing 14 oat wild relatives, listed eight - *Avena atherantha* C. Presl, (syn. *A. sterilis*), *Avena eriantha* Durieu, *A. hybrida*, *A. insularis*, *Avena macrostachya* Balansa ex Coss. & Durieu, *Avena prostrata* Ladiz., *A. strigosa*, and *A. trichophylla* - as of high priority for further collecting, and one other species (*A. murphyi*) as medium priority. Some progress has been made recently in filling these gaps, including via the project Adapting Agriculture to Climate Change: Collecting, Protecting and Preparing Crop Wild Relatives project (Crop Trust, 2025), which resulted in the collecting of 241 seed samples of around 11 oat wild relative taxa from 11 countries (including 10 samples of *A. eriantha*, 1 of *A. hybrida*, and 12 of *A. trichophylla*), as well as the development of new varieties with introgressions from this wild germplasm (Eastwood *et al.*, 2022).

Multilateral System status of accessions in *ex situ* collections

The genus *Avena* is listed in Annex I of the International Treaty on Plant Genetic Resources for Food and Agriculture (Plant Treaty) and is thus included in its Multilateral System of Access and Benefit Sharing (MLS). Of the 115,605 accessions conserved globally, only 0.7% are held in international institutions (i.e., International Center for Agricultural Research in the Dry Areas - ICARDA and International Livestock Research Institute - ILRI), and are included in the MLS under Article 15 of the Plant Treaty, with the remainder maintained in national and other collections (Table 4).

As of 2025, 15,449 accessions are formally included in the MLS according to the Plant Treaty's GLIS database, and 18,179 accessions have been assigned Digital Object Identifiers (DOIs). Per the relevant fields in the global genetic resources databases, 56,471 accessions (48.8% of world total) are listed as included in the MLS; this is likely an underestimate, noting that 42.6% of accessions do not have MLS status data. The discrepancies between the GLIS data and the global genetic resources data indicates that several institutions have not registered or recently updated their registrations in the GLIS portal.

Table 4. Representation of oat 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 (2024). DOI and MLS data from Plant Treaty GLIS (2025).

Metric	Number	Percentage
Number of accessions in genebank collections in international institutions	806	0.7%
Number of accessions in genebank collections in national or other institutions	114,799	99.3%
Number of accessions in genebank collections in Annex I	115,605	100%
Number of accessions with DOI (Plant Treaty GLIS 2025)	18,179	
Number of accessions included in the Multilateral System (MLS) (Plant Treaty GLIS 2025)	15,449	
Number of accessions included in the Multilateral System (MLS) (genebank collections databases)	56,471	48.8%
Number of accessions included in the Multilateral System (MLS) that are in international collections (genebank collections databases)	762	0.7%
Number of accessions not included in the Multilateral System (MLS) (genebank collections databases)	9,898	8.6%
Number of accessions without information regarding inclusion in the Multilateral System (MLS) (genebank collections databases)	49,236	42.6%

Storage conditions, regeneration status, and safety duplication

As expected for an orthodox seed crop, almost the entirety (at least 94.3%) of oat accessions are conserved as seed, with 83.9% of these accessions listed as conserved under long-term cold-storage conditions (Table 5). Information on storage in general is missing for 5.6% of all accessions, and on seed storage type (i.e., long, medium, or short term) for 0.7% of seed accessions.

Current regeneration status and needs cannot be directly derived from the global germplasm databases. The 2008 Strategy listed numbers of accessions per species in need of regeneration at that time per institute. The Strategy remarked that regeneration backlog was the most urgent problem facing oat *ex situ* collections, especially for wild species, and that even collections such as those in Canada and the USA had backlogs of many thousands of accessions. Lack of sufficient staff was considered a main constraint (Crop Trust, 2008). 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 2,208 oat accessions regenerated during this time by reporting institutions, with 3,367 accessions identified as needing regeneration and 2,263 of these lacking funds to conduct the regeneration.

Analysis of the location of safety duplication sites of oat germplasm, as listed in Genesys, indicates that only 1.5% of accessions listed 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 oat accessions worldwide, when also considering safety duplication within the same country, may be considerably higher than this estimate, given a number of national genebanks (such as the USA and Russian Federation) typically provide safety backup their collections in a different location within the country. Information from the SGSV database from 2024 indicated that approximately 16.9% of total accessions worldwide were duplicated in Svalbard. The 2008 Strategy remarked that safety duplication of oat collections was, at that time, "not yet very popular" (Crop Trust, 2008). That still seems to be the case.

Table 5. Storage conditions of oat *ex situ* collections, regeneration status, and safety duplication status. Main *ex situ* collections data from Genesys and FAO WIEWS (2024). Regeneration status information from FAO WIEWS (2024); data from 2012 to 2014. Safety duplication out of the country data based only on Genesys (2024) data. Svalbard Global Seed Vault data from SGSV portal (2024).

Metric	Number	Percentage
Number of accessions held in seed storage in genebank collections	109,064	94.3%
Number of accessions held in short-term seed storage in genebank collections	0	0%
Number of accessions held in medium-term seed storage in genebank collections	16,815	15.4%
Number of accessions held in long-term seed storage in genebank collections	91,446	83.9%
Number of accessions held in seed storage of undefined type in genebank collections	803	0.7%
Number of accessions held in field storage in genebank collections	66	0.06%
Number of accessions held in *in vitro* storage in genebank collections	0	0.00%
Number of accessions held in cryo storage in genebank collections	13	0.01%
Number of accessions held as DNA in genebank collections	20	0.02%
Number of accessions held in other storage in genebank collections	0	0%
Number of accessions not marked with a storage type in genebank collections	6,516	5.6%
Number of accessions in genebank collections regenerated 2014–2019	2,208	15.3%
Number of accessions in genebank collections in need of regeneration 2014–2019	3,667	25.4%
Number of accessions in genebank collections in need of regeneration without budget for regeneration 2014–2019	2,263	15.7%
Number of accessions safety duplicated out of the country in genebank collections	97	1.5%
Number of accessions in genebank collections safety duplicated in Svalbard	19,495	16.9%

Documentation, information systems, and research resources

A descriptor list for oats was published in 1985 and is available online (IBPGR, 1985). The estimated completeness of passport information for oat accessions listed in Genesys was 4.7 on a scale of 0 (no data) to 10 (complete data), which indicates that some data is available, but also that there are substantial gaps that it would be valuable to fill. Four metrics of the current degree of digital sequence information (DSI) for oat (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.

At the time of the 2008 Strategy, many collections had simple information management systems, often offline and with large amounts of missing passport and other data (Crop Trust, 2008). The stakeholder workshop also noted that a global registry of oat collections, including passport, phenotyping, genetic, and other data, was a major priority, and that due to several systems (such as GRIN and EURISCO) already existing, it might be sensible to build upon these systems. Immediate priorities included further georeferencing of collections where needed, and application of the Focused Identification of Germplasm Strategy (FIGS) approach to identify potential resistance to stresses (Crop Trust, 2008).

Information management for crop genetic resources has evolved substantially since the 2008 Strategy. The current Genesys and FAO WIEWS databases offer some essential taxonomic, institutional, and passport data, and Genesys now holds some characterization data for the crop, but a dedicated online information system including accession-level characterization and evaluation data for oat germplasm collections remains a gap.

Table 6. Documentation, information systems, and research resources for oats. Passport data completeness index (PDCI) from Genesys (2024), 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	4.65
Number of genes as recorded in NCBI's Entrez database as of 2022	158
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	89,942
Number of proteins as recorded in NCBI's Entrez database as of 2022	119,213
Number of publications listed in Google Scholar with taxon name in title published between 2009 and 2019	1,480
Number of publications listed in PubMed Central with taxon name in text as of 2022	9,515
Number of research materials as recorded in GBIF (2025)	719,760

Germplasm distributions and varietal registrations and releases

Germplasm distributions and varietal development statistics for oats 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). Oat germplasm is distributed and registered/released in significant quantities, although to a much lesser degree than major cereals such as wheat, maize, rice, and barley (Khoury *et al.*, 2023).

Table 7. Oat 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	3,419.6
Average annual number of samples distributed worldwide as recorded in FAO WIEWS	4,370.0
Average annual number of samples distributed worldwide as recorded in the Plant Treaty Data Store	3,181.3
Number of countries receiving germplasm as recorded in the Plant Treaty Data Store	22.0
Evenness of distributions across world regions as recorded in the Plant Treaty Data Store	0.8
Average annual number of varietal registrations worldwide as recorded in UPOV's PLUTO	159.0
Average annual number of varietal releases worldwide as recorded in FAO WIEWS	30.2

Networks and partnerships

Currently active networks include:

- The European Cooperative Programme for Plant Genetic Resources (ECPGR) *Avena Working Group*
- International Oat Nursery
- Uniform Oat Winter Hardiness Nursery
- The USDA ARS Oat Crop Germplasm Committee (and here)

Conclusions

Oats continue to be an important cereal crop globally and it is likely that it will grow in importance in future food systems for both human health and environmental sustainability aims. Oat genetic resources are bolstered by the activities taking place mainly in several major collections held in national agricultural research organizations, particularly in Canada, the USA, Russian Federation, Australia, and Germany. Although difficult to discern clearly from available data, there appears to have been some significant progress made in information systems and safety duplication over the past two decades for several collections, there are considerable associated research resources, and there has been significant activity in germplasm distributions and varietal development for the crop. These data also indicate that further efforts are needed to fill gaps in existing collections through collecting of wild relatives and landraces, to more fully include oat germplasm collections under the MLS of the Plant Treaty, to make the information accompanying accessions more complete and/or more accessible in online databases, and to address regeneration and safety duplication backlogs.

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 oat genetic resources, in descending order by total number of accessions. Number of accessions and storage condition information from Genesys and FAO WIEWS (2024), 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)
CAN004	Plant Gene Resources of Canada, Saskatoon Research and Development Centre	28,514	24.7%	24.7%	28,514	0	28,514
USA029	National Small Grains Collection, USDA-ARS	20,797	18.0%	42.7%	20,780	0	0
RUS001	N.I. Vavilov All-Russian Research Institute of Plant Industry	10,445	9.0%	51.7%	10,445	0	0
AUS165	Australian Grains Genebank, Agriculture Victoria	5,095	4.4%	56.1%	Not listed*	4,885	4,252
DEU146	Genebank, Leibniz Institute of Plant Genetics and Crop Plant Research	4,858	4.2%	60.3%	4,844	4,856	4,858
KEN212	Genetic Resources Research Institute	4,197	3.6%	63.9%	4,197	760	4,197
GBR016	Genetic Resources Unit, Institute of Biological, Environmental & Rural Sciences, Aberystwyth University	2,781	2.4%	66.3%	Not listed	0	21
POL003	Plant Breeding and Acclimatization Institute	2,676	2.3%	68.7%	2,663	0	2,256
BGR001	Institute for Plant Genetic Resources 'K.Malkov'	2,672	2.3%	71.0%	1,958	0	0
GBR247	Germplasm Resources Unit, John Innes Centre, Norwich Research Park	2,640	2.3%	73.2%	2,640	0	0
MAR088	Centre Régional de la Recherche Agronomique de Settat	2,422	2.1%	75.3%	Not listed	0	0
CZE122	Gene bank	2,204	1.9%	77.2%	2,204	97	2,204
ESP004	Centro Nacional de Recursos Fitogenéticos	1,709	1.5%	78.7%	1,680	0	1,306

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)
ISR003	Lieberman Germplasm Bank, Institute for Cereal Crops Improvement, Tel-Aviv University	1,592	1.4%	80.1%	Not listed	0	0
JPN183	NARO Genebank	1,444	1.2%	81.4%	292	781	781
MNG030	Institute of Plant and Agricultural Science	1,429	1.2%	82.6%	6	0	3
IND001	National Bureau of Plant Genetic Resources	1,395	1.2%	83.8%	1,395	0	0
HUN003	Centre for Plant Diversity	1,343	1.2%	85.0%	424	0	42
SVK003	Breeding Research Station	1,008	0.9%	85.8%	15	0	1,008
SWE054	Nordic Genetic Resource Center	997	0.9%	86.7%	997	1,738	997
TUR034	Field Crop Central Research Institute	950	0.8%	87.5%	950	0	0
ITA386	CREA-Centro di Ricerca Cerealicoltura e Colture Industriali - Sede di Bergamo	939	0.8%	88.3%	Not listed	953	28
BLR011	Republican Unitary Enterprise 'Research and Practical Centre of the National Academy of Sciences of Belarus for Arable Farming'	900	0.8%	89.1%	757	0	0
ITA382	CREA-Centro di Ricerca Genomica e Bioinformatica - Sede di Fiorenzuola d'Arda	899	0.8%	89.9%	Not listed	0	0
ROM007	Suceava Genebank	784	0.7%	90.6%	371	138	138
LBN002	International Centre for Agricultural Research in Dry Areas	683	0.6%	91.1%	Not listed	639	639
URY003	INIA La Estanzuela	671	0.6%	91.7%	671	0	0
UZB006	Uzbek Research Institute of Plant Industry	648	0.6%	92.3%	Not listed	0	0
PAK001	Plant Genetic Resources Program	611	0.5%	92.8%	547	0	559
ECU023	Departamento Nacional de Recursos Fitogenéticos	604	0.5%	93.3%	601	0	600

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)
FRA040	Génétique Diversité et Ecophysiologie des Céréales, Plant Biology and Breeding, INRAE Clermont-Ferrand	603	0.5%	93.9%	603	0	603
USA995	National Center for Genetic Resources Preservation	603	0.5%	94.4%	603	0	0
CHL150	Banco Activo INIA Carillanca	562	0.5%	94.9%	Not listed	0	0
BEL001	CRA-W, Centre wallon de Recherches agronomiques, Département de la Lutte Biologique et Ressources Phytogénétiques - Sélection céréalière	515	0.4%	95.3%	Not listed	0	515
BRA003	Embrapa Recursos Genéticos e Biotecnologia	514	0.4%	95.8%	514	0	0
BRA015	Embrapa Trigo	477	0.4%	96.2%	Not listed	0	475
UKR007	Institute of Agriculture & Cattle-breeding of the Western Region	445	0.4%	96.6%	126	0	0
AUT001	Austrian Agency for Health and Food Safety	412	0.4%	96.9%	367	0	412
TUR001	Plant Genetic Resources Department	408	0.3%	97.3%	408	0	0
NLD037	Centre for Genetic Resources, the Netherlands	398	0.3%	97.6%	398	403	398
PRT001	Banco Português de Germoplasma Vegetal	370	0.3%	97.9%	266	0	370
GBR004	Millennium Seed Bank - Royal Botanic Gardens Kew	306	0.3%	98.2%	Not listed	0	247
UKR008	Ustymivka Experimental Station of Plant Production	305	0.3%	98.5%	68	0	0
EST019	Estonian Crop Research Institute	187	0.2%	98.6%	187	0	187
ETH013	International Livestock Research Institute	122	0.1%	98.7%	Not listed	122	122

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)
MEX208	INIFAP, Centro Nacional de Recursos Genéticos (CNRG)	122	0.1%	98.8%	122	0	0
TUN029	Banque Nationale de Gènes de Tunisie	116	0.1%	98.9%	116	0	114
ISR002	Israel Gene Bank for Agricultural Crops, Agricultural Research Organisation, Volcani Center	90	0.1%	99.0%	32	0	0
LVA009	Latvian State Forest Research Institute 'Silava'	84	0.1%	99.1%	84	0	84
CYP004	National (CYPARI) Genebank, Agricultural Research Institute, Ministry of Agriculture, Rural Development and Environment	75	0.1%	99.1%	37	0	22
ETH085	Ethiopian Biodiversity Institute	63	0.0%	99.2%	51	0	38
TJK027	National Center for Genetic Resources	63	0.0%	99.3%	44	0	63
AZE015	Genetic Resources Institute	57	0.0%	99.3%	30	0	56
JOR105	National Agricultural Research Center	57	0.0%	99.4%	Not listed	47	47
KGZ040	Bank-Laboratory of Plant Genetic Resources of the KR	52	0.0%	99.4%	48	0	52
CHL171	Banco de Semillas SAG Magallanes	49	0.0%	99.4%	49	0	0
LTU001	Lithuanian Institute of Agriculture	46	0.0%	99.5%	34	0	43
CHE001	Agroscope Changins	45	0.0%	99.5%	45	0	45
GBR165	Science and Advice for Scottish Agriculture, Scottish Government	44	0.0%	99.6%	44	0	0
NZL001	Margot Forde Genebank, AgResearch Ltd	44	0.0%	99.6%	Not listed	0	0
PRT102	Banco de Germoplasma - Universidade da Madeira	43	0.0%	99.6%	43	0	43
AUT005	Genebank Tirol	39	0.0%	99.7%	13	0	39

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)
GRC005	Greek Genebank, Institute of Plant Breeding and Genetic Resources	39	0.0%	99.7%	Not listed	0	0
LBY006	National Bank for Plant Genetic Resources	36	0.0%	99.7%	Not listed	0	0
ITA436	Istituto di Bioscienze e Biorisorse, Consiglio Nazionale delle Ricerche	33	0.0%	99.8%	Not listed	0	0
IRL029	Department of Agriculture, Fisheries and Food, National Crop Variety Testing Centre	30	0.0%	99.8%	30	0	29
MKD001	Faculty of Agriculture, University Ss. Cyril and Methodius	28	0.0%	99.8%	28	0	0
ROM023	University of Agricultural Sciences and Veterinary Medicine Timisoara	21	0.0%	99.8%	Not listed	0	0
BIH039	Institute of Genetic Resources, University of Banja Luka	20	0.0%	99.8%	6	0	0
ALB026	Plant Genetic Resources Center	19	0.0%	99.9%	19	0	18
LBN020	Lebanese Agricultural Research Institute	17	0.0%	99.9%	17	17	3
ARM005	Institute of Botany	13	0.0%	99.9%	13	0	12
HRV053	Center for Seed and Seedlings	11	0.0%	99.9%	11	0	11
GRC100	CIHEAM Mediterranean Agronomic Institute of Chania	10	0.0%	99.9%	10	0	0
MEX006	UACh, Banco Nacional de Germoplasma Vegetal (BANGEV)	10	0.0%	99.9%	7	0	0
ARM010	Armenian Botanical Society	9	0.0%	99.9%	Not listed	0	0
LSO015	Lesotho National Plant Genetic Resources Centre	8	0.0%	99.9%	Not listed	0	0
GHA091	Plant Genetic Resources Research Institute	7	0.0%	99.9%	Not listed	6	6

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)
ARG1351	Banco Activo de Germoplasma de Anguil	6	0.0%	99.9%	Not listed	0	0
ARM059	Agrobiotechnology Scientific Center	6	0.0%	99.9%	1	0	1
ESP172	Cabildo Insular de Tenerife. Centro de Conservación de la Biodiversidad Agrícola de Tenerife	6	0.0%	100.0%	Not listed	0	6
UKR061	Verkhniachka Experimental Station	6	0.0%	100.0%	Not listed	0	0
COL017	Corporación Colombiana de Investigación Agropecuaria, AGROSAVIA	4	0.0%	100.0%	4	0	0
GRC001	Cereal Department, Institute of Plant Breeding and Genetic Resources	4	0.0%	100.0%		0	0
MNE001	Institute of Agriculture	4	0.0%	100.0%	4	0	0
NPL069	National Agriculture Genetic Resources Centre-Genebank	4	0.0%	100.0%	4	0	0
ARG1408	Instituto de Investigación y Desarrollo Hortícola Semillero	3	0.0%	100.0%	Not listed	0	0
BLR014	State research institution 'Institute of Experimental Botany of the National Academy of Sciences of Belarus'	3	0.0%	100.0%	3	0	0
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%	100.0%	Not listed	0	3
GRC102	Hellenic Mediterranean University	3	0.0%	100.0%	Not listed	0	0
SVN019	Crops and Seed Production Department, Agricultural Institute of Slovenia	3	0.0%	100.0%	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)
ESP010	Junta de Extremadura. Dirección General de Ciencia y Tecnología. Centro de Investigación Agraria Finca La Orden - Valdesequera.	2	0.0%	100.0%	Not listed	0	0
ITA363	Dipartimento di Chimica, Biologia e Biotecnologie, Universitá degli Studi Perugia	2	0.0%	100.0%	2	0	0
ITA435	Banca del Germoplasma Vegetale	2	0.0%	100.0%	2	0	2
ARE003	International Center for Biosaline Agriculture	1	0.0%	100.0%	Not listed	1	1
ERI003	National Agricultural Research Institute	1	0.0%	100.0%	1	0	0
GEO013	Niko Ketskhoveli Institute of Botany	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
HRV015	Bc Institute for Breeding and Production of Field Crops	1	0.0%	100.0%	Not listed	0	0
HRV041	Faculty of Agriculture, University of Zagreb	1	0.0%	100.0%	Not listed	0	0
MDG038	Fiompiana Fambolena Malagasy Norvéziana	1	0.0%	100.0%	Not listed	0	1
MEX263	SNICS, Depositario Nacional de Referencia de Semillas (DNRS)	1	0.0%	100.0%	Not listed	0	0
SDN002	Agricultural Plant Genetic Resources Conservation and Research Centre	1	0.0%	100.0%	1	0	0
USA151	National Arboretum-Germplasm Unit, USDA/ARS	1	0.0%	100.0%	Not listed	0	0

*But documented in the 2008 Strategy as maintaining collections in long-term conditions (Crop Trust, 2008)

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 (2024).

Taxon	Number of accessions (from genebank collections databases)
Avena sativa L.	73,252
Avena sterilis L.	22,747
Avena L.	5,077
Avena barbata Pott ex Link	3,433
Avena fatua L.	2,625
Avena byzantina K. Koch	2,369
Avena strigosa Schreb.	1,160
Avena magna H. C. Murphy & Terrell	1,083
Avena abyssinica Hochst. ex A. Rich.	777
Avena hybr.	560
Avena damascena Rajh. & B. R. Baum	277
Avena agadiriana B. R. Baum & Fedak	263
Avena longiglumis Durieu	249
Avena eriantha Durieu	231
Avena vaviloviana (Malzev) Mordv.	219
Avena brevis Roth	186
Avena murphyi Ladiz.	147
Avena hirtula Lag.	140
Avena nuda L.	140
Avena clauda Durieu	120
Avena wiestii Steud.	80
Avena canariensis B. R. Baum et al.	79
Avena occidentalis Durieu	72
Avena ventricosa Balansa ex Coss.	65
Avena hispanica Ard.	45
Avena prostrata Ladiz.	45
Avena lusitanica (Tab. Morais) B. R. Baum	40
Avena atlantica B. R. Baum & Fedak	34
Avena hybrida Peterm.	34
Avena trichophylla K. Koch	19
Avena macrostachya Balansa ex Coss. & Durieu	18
Avena insularis Ladiz.	10
Avena chinensis (Fisch. ex Roem. & Schult.) Metzg.	7
Avena x *glabrata* Hausskn.	1
Avena x *haussknechtii* Nevski	1

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