

# Global strategy for the conservation and use of citrus genetic resources: summary for ITPGRFA stakeholders

This document is a concise summary of the [Global strategy for the conservation and use of citrus genetic resources](#) (Volk et al 2023a). This summary supports decision making by the stakeholders of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) by providing evidence-based information in an accessible format.

## Composition of ex situ collections

A total of 15,555 genebank accessions are maintained in the 33 collections around the world that provided inventory information. The largest number of genebank accessions maintained are commercial and local cultivars, followed by materials for breeding, seedlings, and rootstocks with some wild materials. The largest accession holdings across all the collections are mandarins and sweet oranges.

## Routine operations and quality management system

Citrus collections are primarily maintained in the field or greenhouse/screenhouse. Collections maintained in a clean state are mostly kept in protected environments. The two collections with significant *in vitro* components are Federal Research Centre the Sub-tropical Scientific Centre of the Russian Academy of Sciences in Russia and the Instituto Valenciano de Investigaciones Agrarias (IVIA) in Spain. The extent of duplicate plantings varies

considerably. Some collections have a single tree in the field for each accession, others have a partial greenhouse duplication, many have two to five trees in the field or in greenhouse pots for each accession.

## Safety duplication

Collections are rarely duplicated or backed-up at secondary locations, although a substantial portion of the USDA-ARS collection is being cryopreserved as shoot tips in liquid nitrogen. Collection back-up strategies vary. Some respondents stated that accessions are duplicated in other collections either within-country or internationally.

Some collections rely on greenhouse backups of field collections, and IVIA maintains *in vitro* collection back-ups. Some responses stated that accessions unique to specific collections are re-propagated as needed. Some collections cryopreserve recalcitrant seeds and/or embryos (INRAE, New Delhi) and over 400 accessions are cryopreserved as shoot tips by USDA-ARS.

Key metrics	Data source	Value	%
Estimated global number of accessions ex situ	Survey <sup>1</sup> (2021)	15,555	
Estimated global number of accessions ex situ	Genesys and FAO-WIEWS (2021)	5,970	
Estimated global number of accessions in the MLS	<a href="#">GLIS portal</a> (2024)	100	0.6%
Accessions with DOI	<a href="#">GLIS portal</a> (2024)	185	1.2%
Number of samples distributed per year	Survey (2021)	3750	
<a href="#">Passport data completeness index</a> : median value in Genesys (Range 0-10)	<a href="#">Genesys</a> (2024)	5.15	

<sup>1</sup>2021 survey data from 33 respondents.

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Barriers to collection back-ups include resources (funding, time), lack of skilled workers, facilities, orchard space, as well as international intellectual property rights (IPR) for commercial cultivars. No citrus genetic resources are backed up at the Svalbard Global Seed Vault because liquid nitrogen storage is necessary for long-term seed and shoot tip preservation.

### Crop descriptors

Most collections use the IPGRI citrus descriptors for standardized phenotyping (IPGRI, 1999). Additional descriptor lists are published by the International Union for the New Varieties of Plants (UPOV) (2003, 2013).

### Documentation and information systems

Eleven collections have databases with information that is available to the public to some extent. Citrus genomic data, including some generated from materials in genebank collections, are available in publicly available external databases. Collections that do not have publicly available databases usually store information on local databases and spreadsheets. Genesys aggregates information for 10 citrus collections worldwide.

### Human and financial resources

Most collections are limited by a lack of staffing. Some collections only have a manager and some field personnel. Others are entirely without dedicated personnel. Budgets range from reasonable institutional support to basic maintenance efforts supported from research grant proposals. Overall, respondents stated that additional financial resources were needed for citrus collection management. About half of the collections responded that resource inadequacies will result in a loss of germplasm in collections.

### Distribution and obstacles to use

Plants in insect-proof protected structures such as screenhouses and greenhouses can be maintained in a pathogen-free state. Budwood from these pathogen-tested trees can generally be distributed. Accessions maintained *in vitro* can be useful as a distribution form when propagation methods, skilled staff and specialized laboratories are available. Seeds are distributed when large numbers of plants are needed for experimental purposes.

In total, an average of 3,750 genebank accessions are distributed to about 350 users annually. Distributions are primarily within the country, with a few collections for which more than 10% of their annual distributions are international (USDA-ARS, Queensland Department of Agriculture and Fisheries). Most of the large collections do not distribute internationally.

### Partnerships and networks

Survey responses listed several organizations that provide opportunities for networking at national, regional and international levels. Examples of networking include:

- India citrus programs are part of an All India Coordinated Research Project (AICRP) on fruits.
- The European Union has joint citrus projects.
- The Iberoamericana para la vigilancia de *Xylella fastidiosa* (IBER-SYFAS) is an Ibero-American effort focused on *Xylella*.
- The International Society of Citriculture, the International Society of Citrus Nurserymen, and the International Organization of Citrus Virologists are international organizations with wide membership and interest in germplasm collections, to ensure the future availability of citrus genetic diversity.





## Recommendations and priorities

- Increase citrus genebank community cooperation by establishing an international working group and developing/using a Citrus Community Information System (CCIS) for citrus and related genera.
- Support data collection and documentation efforts for citrus collections. This includes collecting image and phenotype data for collections and making it publicly available, and genotyping collections to standardize collection identities, duplicates, and overlaps using a common platform.
- Identify taxonomic gaps (cultivars and related genera) in citrus collections and fill gaps through collections and exchange.
- Increase citrus collection health and security (backup), particularly collections that have vulnerable unique plant genetic resources. This includes conducting research and implementing findings to control pests and eradicate pathogens from citrus collections and conducting research and implementing findings for improved long-term storage of citrus seeds and shoot tips in genebanks.
- Provide training opportunities for the citrus genebanking community on a wide range of topics through a combination of affordable in-person and online options.
- Develop, maintain and distribute materials from a clean, secure international citrus collection at one or more locations that captures taxonomic and genetic diversity of citrus.

## Bibliography

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