Ex situ conservation of Plant Genetic Resources

Genebanks in Europe – the *status quo*

Theo van Hintum
Centre for Genetic Resources, The Netherlands (CGN)

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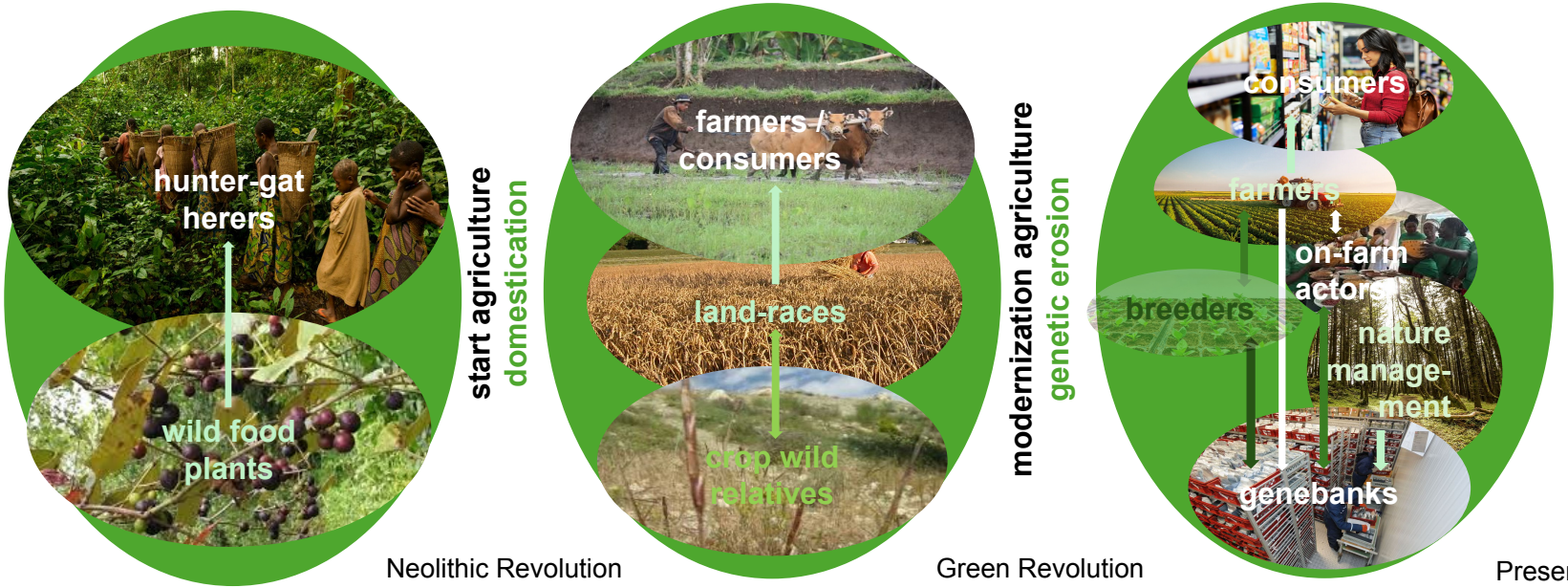
Ex situ conservation of Plant Genetic Resources



Neolithic Revolution
12 000 years ago
5 000 000 people

Green Revolution
<100 years ago
2 500 000 000 people

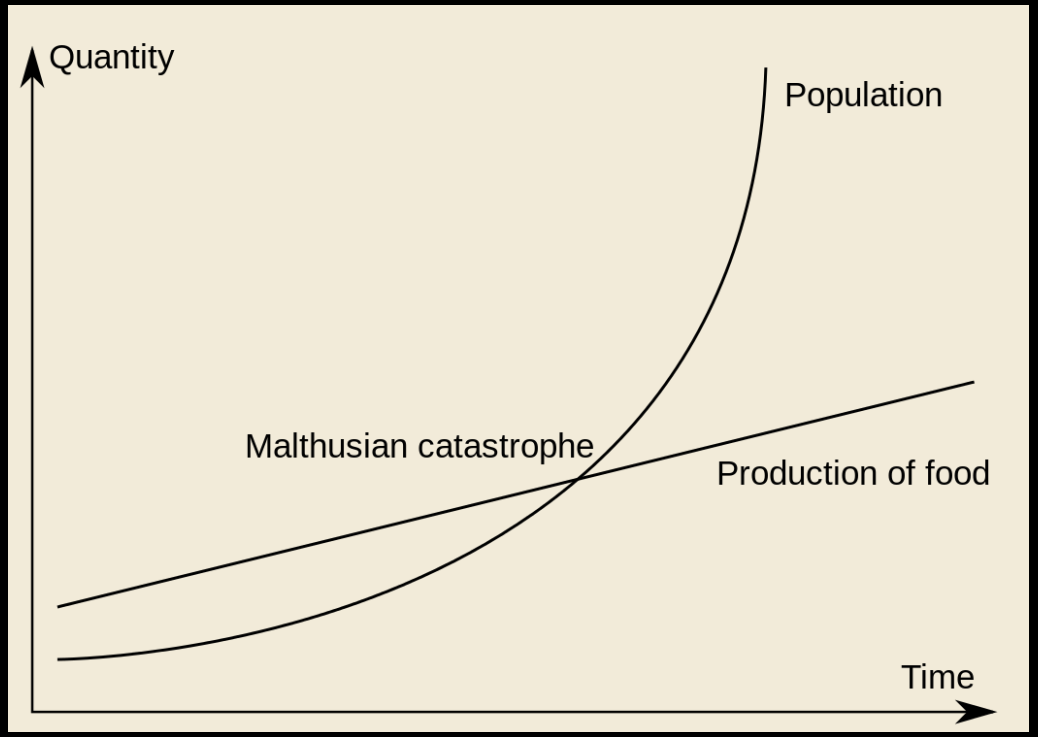
Present Day
8 200 000 000 people

Ex situ conservation of Plant Genetic Resources

- last 10 000 years: food (and PGR) grew in fields and the wild
  - population was small and food production was low
  - relatively stable system
- last century: agriculture & environment changed dramatically
  - due to science, population growth and climate crisis
  - instability, human intervention became needed to preserve PGR
- now: food grows in the field, PGR is conserved in genebanks

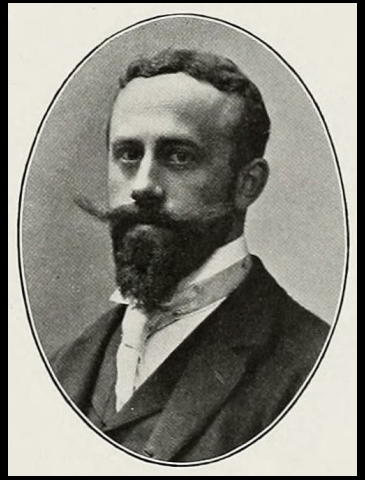
Ex situ conservation of Plant Genetic Resources

Thomas Malthus (1766-1834)



Ex situ conservation of Plant Genetic Resources

Gregor Mendel (1822-1884)

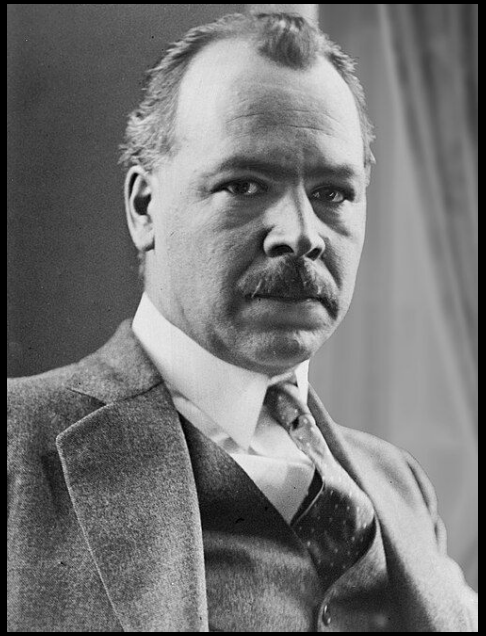


Erich von Tschermak
(1871-1962)

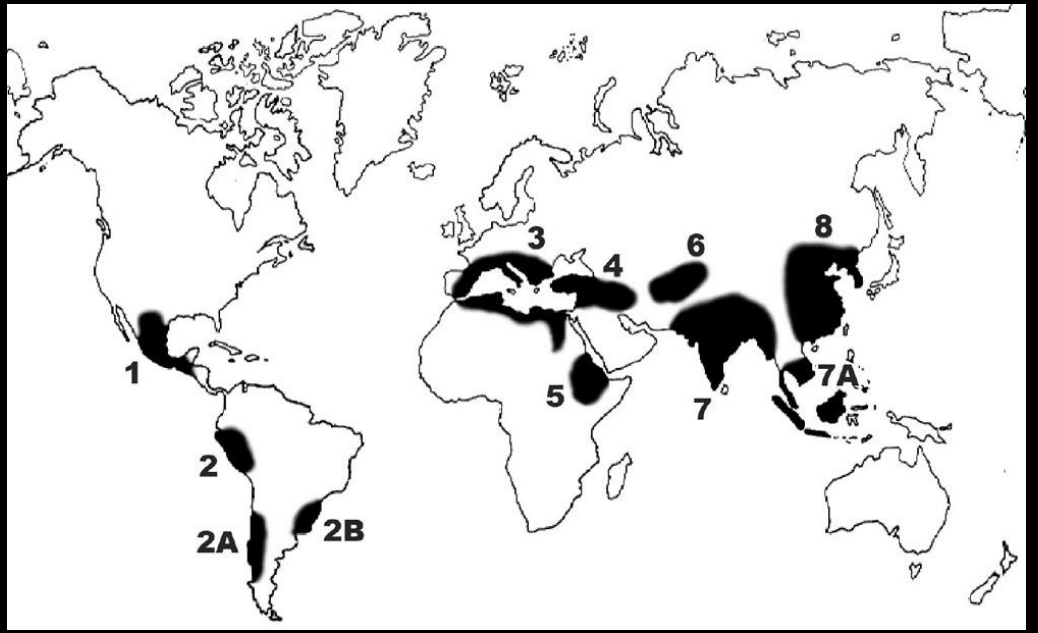
Hugo de Vries
(1848-1935)

Carl Correns
(1864-1933)

Ex situ conservation of Plant Genetic Resources

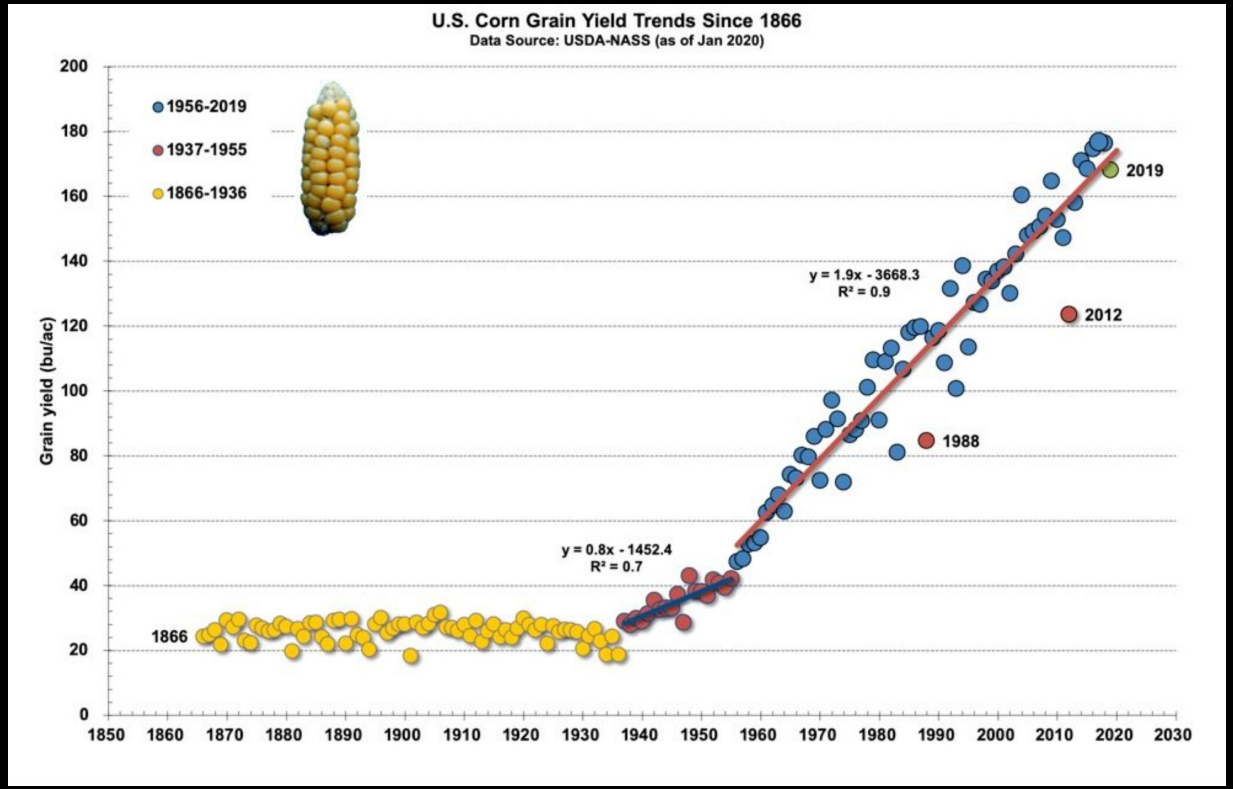


Nikolai Vavilov (1887-1943)



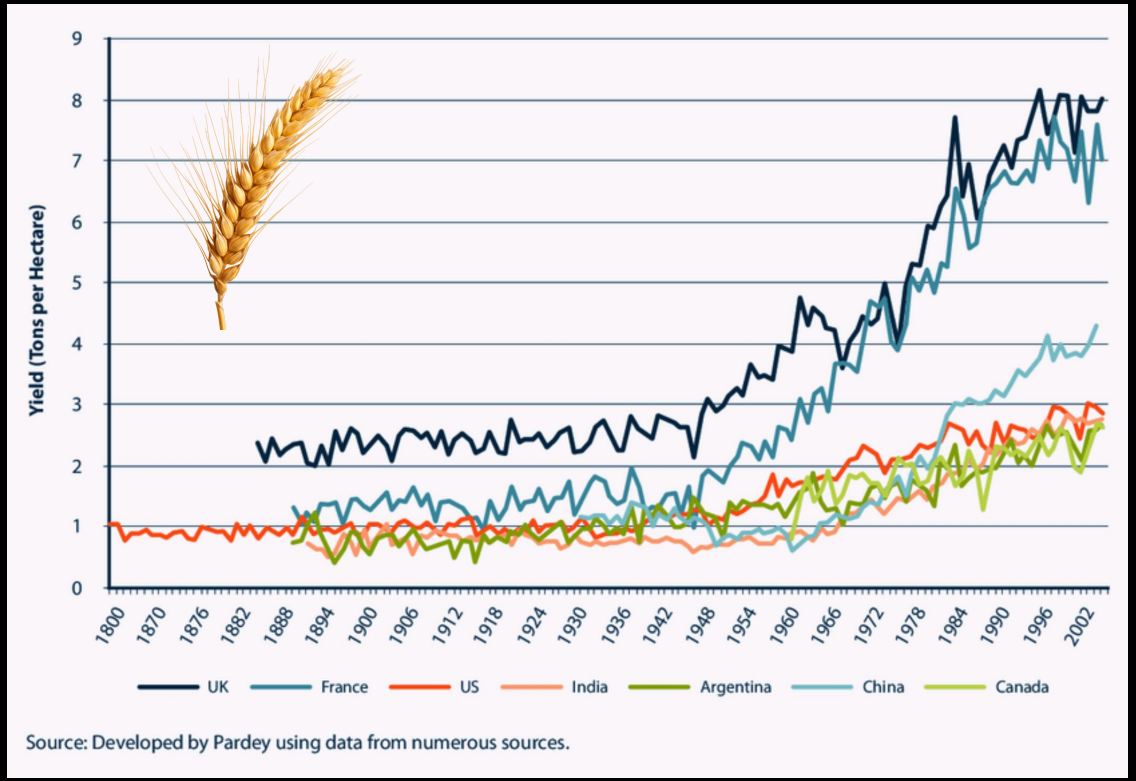
Vavilov's 1924 scheme of centers of origin

Ex situ conservation of Plant Genetic Resources



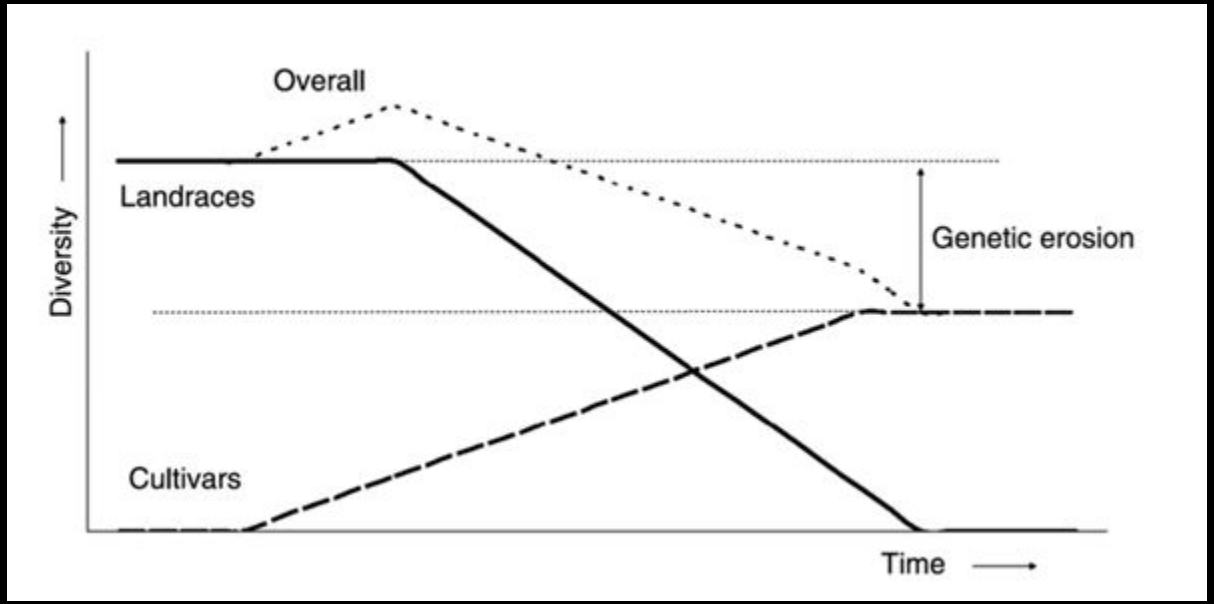
Source:
Nielsen 2020

Ex situ conservation of Plant Genetic Resources



Source:
Pardey *et al* 2007

Ex situ conservation of Plant Genetic Resources



Source:
vd Wouw *et al* 2009

Ex situ conservation of Plant Genetic Resources

- PGR conservation – approaches
  - *ex situ*
    - PGR outside place of origin (in genebank)
    - directly aimed at conserving and providing access
      - collections of seeds, plants, tubes with tissue cultures
      - procedures regarding safety back-up, viability testing, phytosanitary regulations, legal aspects, etc.
  - *in situ* (on-farm)
    - landraces and traditional varieties grown 'for use'
    - conservation and providing access is a spin off
  - *in situ* (in-nature)
    - crop wild relatives
    - nature conservation and other natural occurences

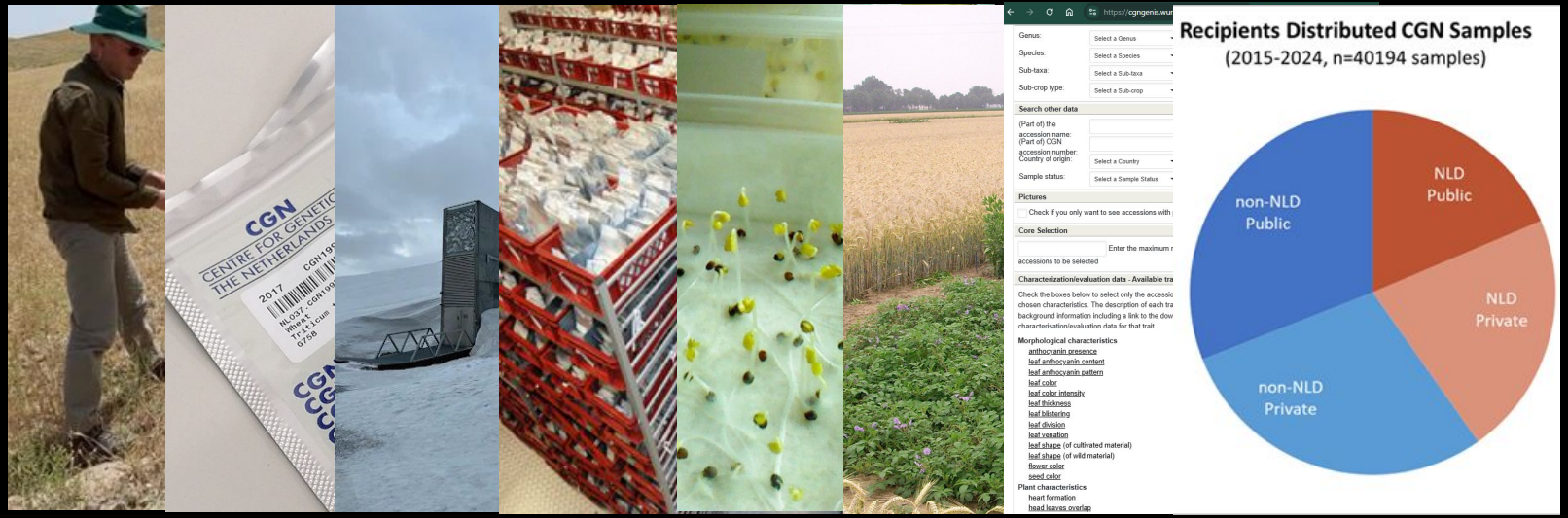
Ex situ conservation of Plant Genetic Resources

- PGR need to be properly managed
  - to avoid loss and create access
    - primarily in dedicated *ex situ* genebanks
    - most CWR in nature with additional back-up and access provisions
    - selected species on-farm with additional back-up and access provisions

- PGR in genebanks needs to be used
  - ultimately by farmers
    - modern agriculture is served well by breeding and seed industry
    - traditional and alternative agriculture needs alternative interface

Ex situ conservation of Plant Genetic Resources

ex situ genebanking

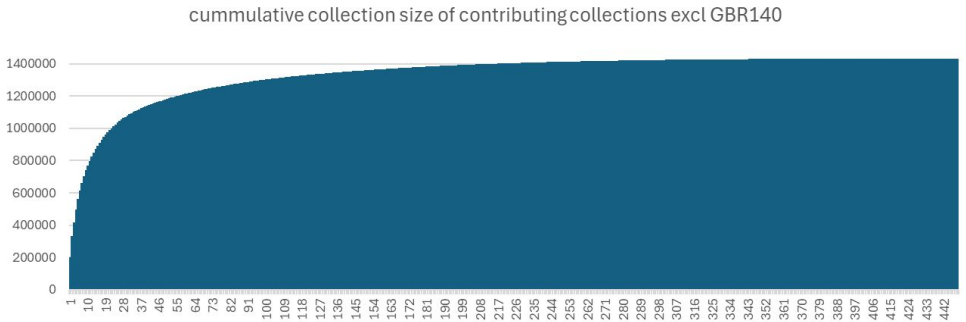


we know how to do it !

how are we doing it ?

Ex situ conservation of Plant Genetic Resources

- status of *ex situ* PGR management in Europe
  - EURISCO gives an overview of European PGR
    - 2 115 525 PGR accessions reported (Aug 25th, 2025)
    - 450 institutes with collections
      - GBR140: 684495 accessions *Arabidopsis*
      - la xcl. GBR140)
      - sı ons (excl. GBR140)



Ex situ conservation of Plant Genetic Resources

- status of *ex situ* PGR management in Europe
  - EURISCO gives an overview of European PGR
    - >2 million PGR accessions reported
      is this material properly managed?
  - information sources
    - Pro-Grace inventory
      - survey determining procedures, standards and quality management in European genebanks
    - genebank peer reviews
      - genebank experts visiting each other in triplets
      - public 'genebank manuals' and reports
    - small-scale assessment of availability of EURISCO accessions

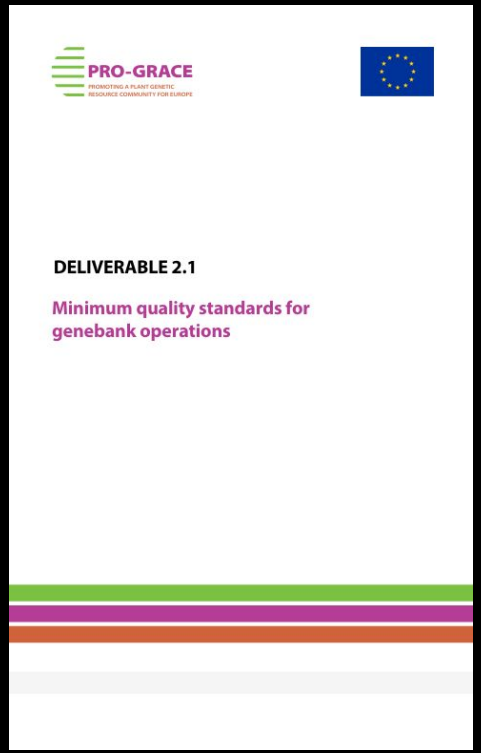
Ex situ conservation of Plant Genetic Resources

- Pro-Grace inventory
  - 61 contacts were approached
    - all most important collection managers in Europe
      - PRO-GRACE partner genebanks + ECPGR Genebank Managers Network + AEGIS Associated Members + EURISCO National Focal Points + contacts from various correspondence
  - 43 replies covering 60 genebanks received
    - 1,053,491 acc's covered
      - at least 'a substantial part' and at best 'the majority' of European PGR in public holdings

Ex situ conservation of Plant Genetic Resources

- Pro-Grace inventory
  - conclusions
    - ISO9001:2015 is standard for quality management
      - c. 25% of genebanks apply it, others indicated they are working towards it
      - >50% use Standard Operating Procedures (SOPs)
        - willing to share in principle - but rarely in practice
    - FAO Genebank Standards are very well known
      - need careful review and adaptation
      - very few genebanks claim they comply completely
      - other standards hardly used
        - ISTA for viability testing & ECPGR Crop Specific
    - 70% of genebanks are interested in working towards certification

Ex situ conservation of Plant Genetic Resources



Ex situ conservation of Plant Genetic Resources

- European genebank peer reviews
  - so far 24 visits were made (8 cycles)
    - involving 18 distinct European genebanks
    - all reports are publicly available
      - interesting reading
  - quality of the genebank operations varies strongly
    - different focus
      - institutional/national/global
    - different funding levels / amount of material
      - communicating vessels
    - different facilities
  - much capacity, many opportunities and many problems!

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Ex situ conservation of Plant Genetic Resources

Genetic Resources

ORIGINAL ARTICLE

Genetic Resources (2025), 6 (11), 115–121
DOI: 10.46265/genresj.OADZ7911
https://www.genresj.org
ISSN: 2708-3764

Genebank Peer Reviews: A powerful tool to improve genebank quality and promote collaboration

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[i] *AGROSCOPE, Changins, Nyon, Switzerland*
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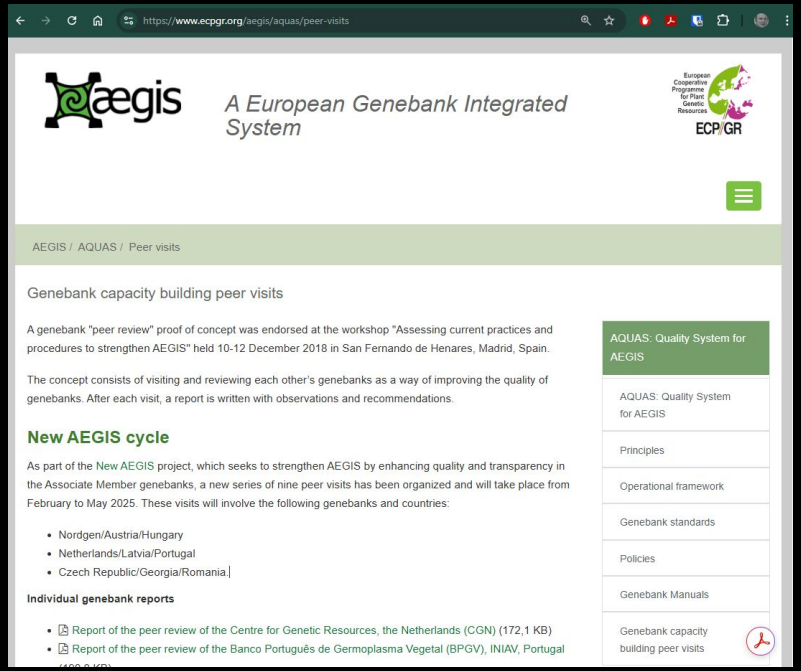
Abstract: The conservation of plant genetic resources (PGR) is critical to ensuring global food security and agricultural sustainability. Genebanks play a vital role in *ex situ* conservation, complementing *in situ* strategies by preserving crop diversity (incl. their wild relatives) and providing access to biological materials for research, breeding and farming. However, maintaining high conservation standards and ensuring accessibility remains a global challenge. To address this, the 'Genebank Peer Review' system was developed as a collaborative quality assessment and improvement mechanism. This system facilitates reciprocal evaluations among genebanks, promoting transparency, capacity building and continuous

Table 1. The Genebank Peer Reviews performed in the period 2019–2024. For the reports and additional information see https://www.ecpgr.org/aegis/aquas/peer-visits.

Insitute of reviewed genebank	Location visited	Date review visit	Reviewers
Centro de Conservación y Mejora de la Agrodiversidad Valenciana (COMAV)	Valencia, Spain	7-8 February 2019	Theo van Hintum (CGN), Wieslaw Podyma (IHAR-PIB)
Centre for Genetic Resources, the Netherlands (CGN)	Wageningen, The Netherlands	6-8 March 2019	Wieslaw Podyma (IHAR-PIB), María José Díez & José Vicente Valcárcel (COMAV)
National Center for Plant Genetic Resources (IHAR-PIB)	Radzików, Poland	16-17 April 2019	María José Díez & José Vicente Valcárcel (COMAV), Theo van Hintum (CGN)
Crop Research Institute (CRI)	Prague, Czech Republic	12-13 May 2022	Pavol Hauptvogel (RIPP), Ulrike Lohwasser (IPK), Theo van Hintum (CGN)
Leibniz Institute of Plant Genetics and Crop Plant Research (IPK)	Gatersleben, Germany	19-20 July 2022	Dagmar Janovská & Ludmila Papoušková (CRI), Pavol Hauptvogel & Iveta Čičová (RIPP)
Research Institute of Plant Production (RIPP)	Piešťany, Slovakia	23-24 August 2022	Dagmar Janovská & Ludmila Papoušková & Vojtěch Holubec (CRI), Ulrike Lohwasser (IPK)
Centro Nacional de Recursos Fitogenéticos (CRF)	Madrid, Spain	7-8 July 2022	Katya Uzundzhalieva & Gergana Desheva (IPGR), Theo van Hintum (CGN)
Centre for Genetic Resources, the Netherlands (CGN)	Wageningen, The Netherlands	19-20 July 2022	Isaura Martín & Luis Guasch (CRF), Katya Uzundzhalieva & Gergana Desheva (IPGR, Bulgaria)
Institute of Plant Genetic Resources 'Konstantin Malkov' IPGR)	Sadovo, Bulgaria	6-7 October 2022	Luis Guasch & Isaura Martín (CRF), Theo van Hintum (CGN)
Nordic Genetic Resource Center (NordGen)	Alnarp, Sweden	29-30 June 2023	John Dickie (MSB), Theo van Hintum (CGN)
Millennium Seed Bank (MSB)	Ardingly, UK	6-7 July 2023	Theo van Hintum (CGN), Lise Lykke Steffensen (NordGen)
Centre for Genetic Resources, the Netherlands (CGN)	Wageningen, The Netherlands	21-22 September 2023	Lise Lykke Steffensen (NordGen), John Dickie & Sharon Balding (MSB)
National Center for Plant Genetic Resources (IHAR-PIB)	Radzików, Poland	21-23 October 2024	Beate Schierscher-Viret (AGROSCOPE), Patrizia Vaccino (CREA-CI)
Research Center for Cereal and Industrial Crops (CREA-CI)	Vercelli, Italy	23-24 September 2024	Maja Boczkowska (IHAR), Beate Schierscher-Viret (AGROSCOPE)
Agroscope Changins (AGROSCOPE)	Nyon, Switzerland	25-26 September 2024	Patrizia Vaccino (CREA-CI), Maja Boczkowska (IHAR)

Ex situ conservation of Plant Genetic Resources



New-AEGIS Genebank Peer Review

Genebank reviewed:	Latvian Gene Bank (LGB), Genetic Resource Centre, Latvian State Forest Research Institute "Silava", Salaspils, Latvia.
Date:	8-9.04.2025
Participants LGB:	Agnese Gailīte (Genetic Resource Centre); Dainis Ruņģis (Genetic Resource Centre)
Reviewers:	Erik Wijnker (Centre for Genetic Resources, the Netherlands (CGN, Wageningen, Netherlands); Ana Maria Barata (Banco Português de Germoplasma Vegetal (BPGV), Braga, Portugal).

BACKGROUND

The "Reinforcement of the AEGIS Quality System and EURISCO Data Coverage" (New AEGIS) project aims to enhance the European Genebank Integrated System (AEGIS) and improve the accessibility of plant genetic resource (PGR) data through the EURISCO database. This initiative aligns with the priorities of the European Cooperative Programme for Plant Genetic Resources (ECPGR), focusing on the sustainable conservation of unique European germplasm and the efficient sharing of related data. As part of the AEGIS quality system (AQUAS), peer reviews are conducted to ensure transparency, promote mutual support, and provide valuable feedback on genebank practices. These reviews foster continuous improvement, ensuring that genebanks uphold high operational standards and contribute to a robust, accessible European Collection. Reciprocal peer reviews are carried out by groups of three genebanks, and this report is the result of a review conducted by a group including the Latvian Genetic Resource Centre, the Centre for Genetic Resources in the Netherlands, and the Banco Português de Germoplasma Vegetal in Braga, Portugal.

Ex situ conservation of Plant Genetic Resources

- small-scale assessment of availability of EURISCO accessions
  - 100 accessions from EURISCO were randomly selected
    - from *ex situ* PGR material – 1 413 596 accessions
      - excluding Norwich Arabidopsis Stock Centre and *in situ* material
    - ensuring proportional representation
      - stratified according to collection size
  - selected accessions were requested
    - standardized requesting procedure
  - five months later results were analyzed / submitted for publication
    - without naming any genebank

Ex situ conservation of Plant Genetic Resources

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Author contributions: Both authors contributed equally to the manuscript

A small-scale assessment of the availability of EURISCO accessions

Short running title: Availability of PGR

Keywords: Availability, EURISCO, PGR, Plant genetic resources, SMTA

Abstract

A critical assessment of plant genetic resource (PGR) availability in Europe reveals a significant gap between documented accessions and those that are practically obtainable for researchers and breeders. While the EURISCO database lists over two million accessions, a study of 100 random

Ex situ conservation of Plant Genetic Resources

Availability	Subgroup	# Accs	Notes
Available		38	Material was either received (33 accessions), the request was terminated (2 accessions) or material was lost in the mail (3 accessions)
Possibly available	Request terminated	2	Material may be obtainable if special permission is requested and granted (Availability for research only; MTA)
	Wrong accession was received	1	
Not available	Genebank confirmed non-availability	18	Material not available at genebank
	Process took longer than 5 months	1	Delivery is uncertain
	Genebank did not respond	40	Material could not be requested due to no response
Total		100	

Table 1: availability status of requested material. Accessions have been grouped according to availability status, in which availability was defined as the ability to receive material within a 5 month period.

Source:
Wijnker & Hintum 2025 (submitted)

Ex situ conservation of Plant Genetic Resources

- overall conclusion

  the European *ex situ* genebank community knows what needs to be done and how it should be done, but is not doing it properly

  - needed
    - transparency (regarding genebank operations and risks)
    - capacity building in genebank methodology (how to do things) and quality management (assure it is done)
    - genebank certification (acknowledge the one who do it well)
  - first steps were made in Pro-Grace

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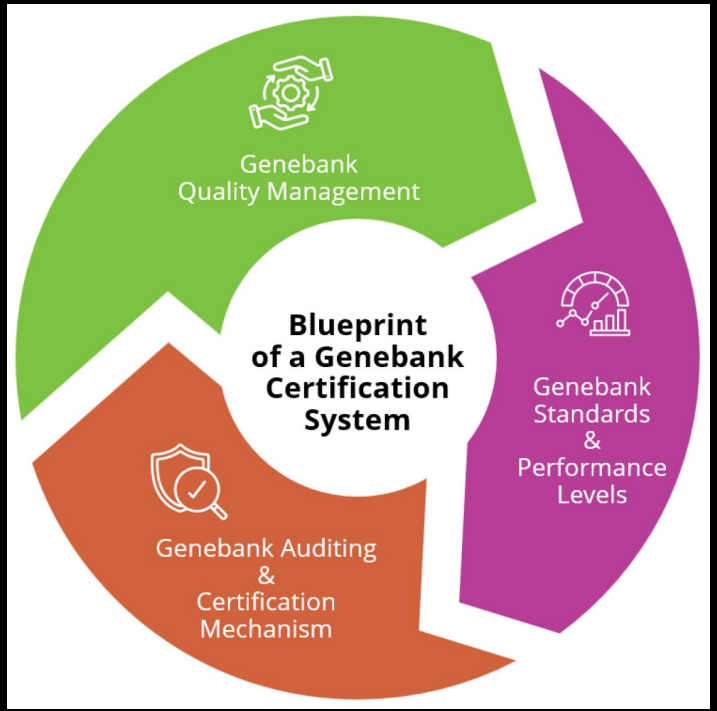

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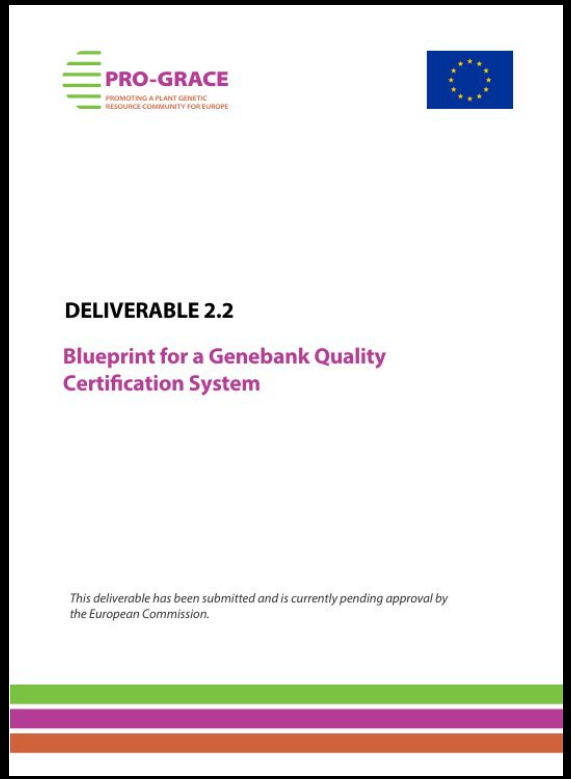

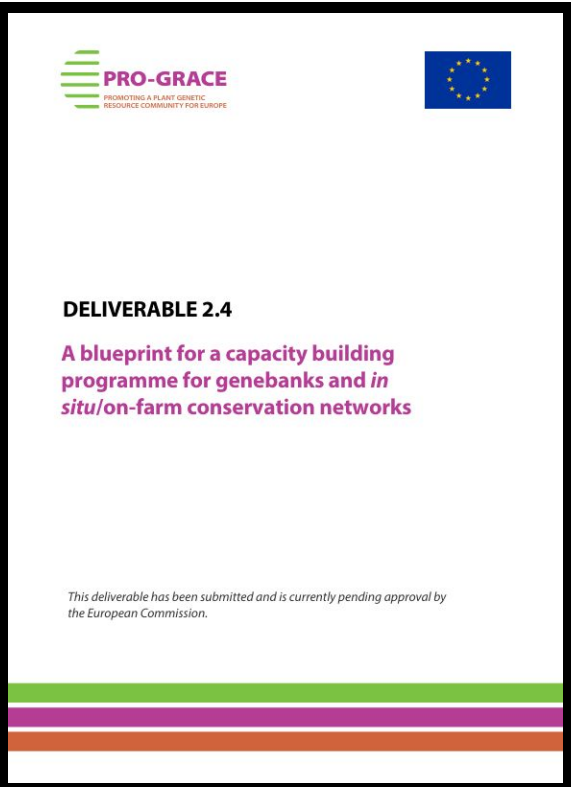

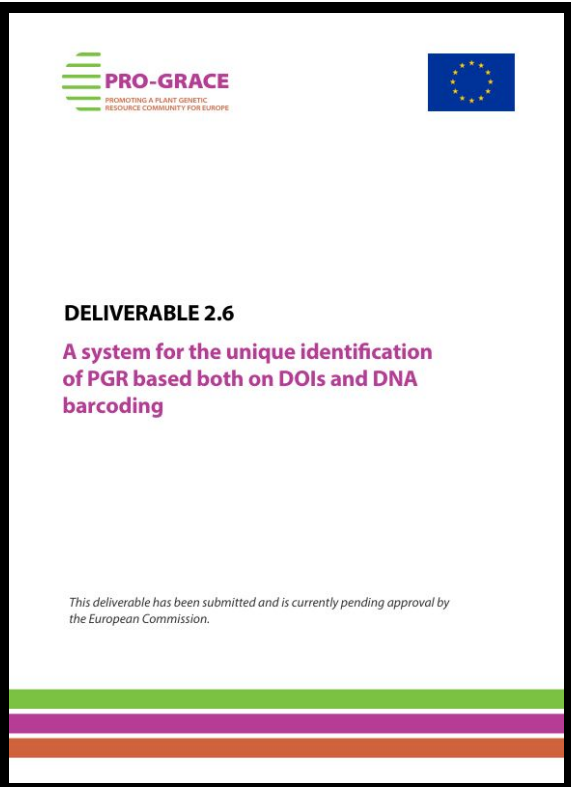

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Ex situ conservation of Plant Genetic Resources

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  the European *ex situ* genebank community knows what needs to be done and how it should be done, but is not doing it properly

  - needed
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    - genebank certification (acknowledge the ones who do it well)
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Thank you for your attention