Improving Quality of European Genebanks

& determining the availability of PGR in Europe

Theo van Hintum & Erik Wijnker

WAGENINGEN
UNIVERSITY & RESEARCH

Centre for Genetic Resources, The Netherlands (CGN)

Improving Quality of European Genebanks

- content
  - quality in European genebanks: *status quo*
    - Pro-Grace inventory
    - availability of material documented in EURISCO: "EURISCO and the PGR Reality"
  - activities aimed at quality improvement
    - genebank peer reviews
    - genebank metrics
    - genebank certification

Improving Quality of European Genebanks

Call identifier: PRO-GRACE
Grant agreement no: 101094738

Promoting a plant genetic resource community for Europe

Deliverable No. D2.1

Minimum quality standards for genebank operations

Contractual delivery date:
M11

Actual delivery date:
M13

Responsible partner:
WR

Contributing partners:
INIAV, KIS, NASC, UOB, UPV, VURV, WORLDVEG

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094738.

WAGENINGEN
UNIVERSITY & RESEARCH

Centre for Genetic Resources, the Netherlands

Improving Quality of European Genebanks

- Pro-Grace inventory
  - 61 contacts were approached
    - PRO-GRACE project + ECPGR Genebank Managers Network + AEGIS Associated Members + EURISCO National Focal Points + 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 official holdings

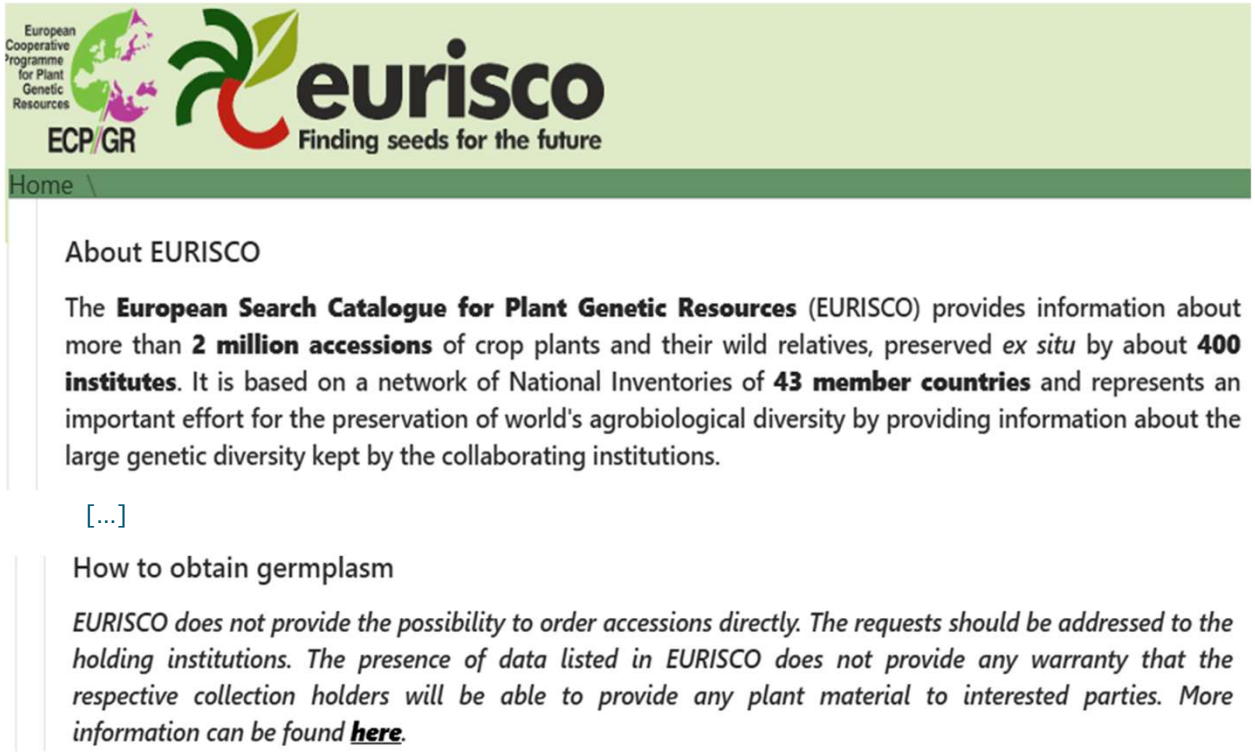
Improving Quality of European Genebanks

- 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

Improving Quality of European Genebanks

- Pro-Grace inventory
  - conclusions
    - 70% of genebanks are interested in working towards certification
      - common fear: costs involved
      - those not interested or very reluctant do not see the added value or are afraid of workload and costs associated with it

EURISCO and the PGR Reality



European Cooperative Programme for Plant Genetic Resources
ECP/GR

eurisco
Finding seeds for the future

Home \

About EURISCO

The **European Search Catalogue for Plant Genetic Resources** (EURISCO) provides information about more than **2 million accessions** of crop plants and their wild relatives, preserved *ex situ* by about **400 institutes**. It is based on a network of National Inventories of **43 member countries** and represents an important effort for the preservation of world's agrobiological diversity by providing information about the large genetic diversity kept by the collaborating institutions.

[...]

How to obtain germplasm

*EURISCO does not provide the possibility to order accessions directly. The requests should be addressed to the holding institutions. The presence of data listed in EURISCO does not provide any warranty that the respective collection holders will be able to provide any plant material to interested parties. More information can be found **here**.*

EURISCO and the PGR Reality

- context
  - various reports and project assume accessions in EURISCO to exist and to be available
    - FAO State of the World
    - Global Crop Conservation Strategies
  - feedback from users indicates differently
  - no monitoring system regarding PGR-reality exists

  - CGN decided to scan the surface

EURISCO and the PGR Reality

- idea
  - select 100 accessions at random from EURISCO *ex situ* PGR accessions
  - request the material
    - document the requesting procedure
    - indicate the use is 'for research purposes'
    - try again if email is not answered at other address
  - register receipt of material
    - check viability and identity
  - analyse the results
    - present / publish ?

EURISCO and the PGR Reality

- doubts
  - potentially we would be ‘wasting’ 100 good accessions and capacity
  - we would be ‘policing’ colleague genebanks
    - purposes were not expressed explicitly
- decisive arguments
  - general impression of availability of PGR in Europe is needed
  - only < 50 out of >2 000 000 accessions would be required < 0.003%

EURISCO and the PGR Reality

- selection of material
  - EURISCO was downloaded January 14th, 2025
    - 2,101,833 records
  - material conserved *in situ* was removed
    - 5,697 *in situ* records
  - material from the Nottingham Arabidopsis Stock Centre was removed
    - 682,541 NASC records
  - remaining: 1,413,596 accessions *ex situ* conserved PGR in 418 collections

EURISCO and the PGR Reality

- selection of material
  - ensure proportional representation
    - collections were ordered by size
    - 1 accession was randomly selected from smallest collections contributing to the first 1% of records, etc.
    - from collections contributing 1% or more, required proportion was randomly sampled
      - largest collection: 14.2% of accessions in EURISCO, 14 accessions were randomly selected
  - result: 100 accessions from 52 collections

EURISCO and the PGR Reality

- searching material
  - 17 coll's (55 acc's) allowed on-line searching
    - some difficult to find (4 times we found it only later)
    - 10 coll's (31 acc's) allowed on-line requesting
      - 4 coll's (9 acc's) used GRIN-Global
        - 1 coll (2 acc's) with GRIN-Global showed 'unavailable' for all accessions – these were requested via contact form
      - 1 coll (1 acc) accession could not be found on-line – this accession was requested via email
      - on-line requesting was annoying
        - registration required, errors, counterintuitive interfaces, etc (but in the end it nearly always worked)

EURISCO and the PGR Reality

- requesting material
  - on February 28th, 2025, material was requested as far as possible
    - 2 coll's (2 acc's) could not be found
      - no email in WIEWS, no web-presence
    - 1 coll (1 acc) showed un-availability
      'Currently, due to lack of resources, we are unable to accommodate new requests.'
    - 3 coll's (4 acc's) request via contact form on website
    - 10 coll's (31 acc's) request via on-line ordering system
    - 36 coll's (62 acc's) no instructions for ordering
      - emails were sent to genebank or institute of genebank

EURISCO and the PGR Reality

- requesting material
  - 13 coll's (33 acc's) March 21st, three weeks after initial request, no reply was received
    - reminders were sent to initial contact, with cc to WIEWS email address(es)
    - result: 5 coll's (5 acc's) replied to reminder

EURISCO and the PGR Reality

- receiving material
  - on May 14th (eleven weeks after requesting)
    - contact with 32 coll's (59 acc's) out of 52 coll's (100 acc's) on the list
      - 6 coll's (7 acc's) material was not available
      - 17 coll's (39 acc's) – 29 acc's received
      - 3 coll's (3 acc's) we decided to terminate transaction (but material could have been obtained)
      - 2 coll's (2 acc's) in the mail
      - 4 coll's (8 acc's) in the process

conclusion: after 11 weeks **29 acc's** were received – potentially another **13** might be (or could have been) received

EURISCO and the PGR Reality

- conditions for receiving material
  - on May 14th (eleven weeks after requesting)
    - 17 coll's (39 acc's) sent 29 accs that was received
      - 15 coll's (37 acc's) required SMTA
        - 8 coll's (21 acc's) easy-SMTA or click-wrap
        - 7 coll's (16 acc's) electronic PDF documents
      - 2 coll's (2 acc's) simply sent the material, no MTA's
    - 2 coll's (2 acc's) transactions were terminated due to very restrictive MTA or requirements
    - 6 coll's (10 acc's) in the process
      - 5 coll's (9 acc's) required SMTA
      - 1 coll (1 acc) required MTA

EURISCO and the PGR Reality

- preliminary conclusions
  - 19.5% - 28.2 % of accessions in EURISCO is obtainable for use
    - based on a sample of 100 accessions
      - allow considerable error
    - nearly all under SMTA
    - between 409K and 594K PGR accessions
      - include considerable duplication
      - composition is not balanced to represent genepools
      - authenticity and seed quality is unknown

EURISCO and the PGR Reality

- take home message

approximately one quarter
of the accessions in EURISCO
are PGR available for use

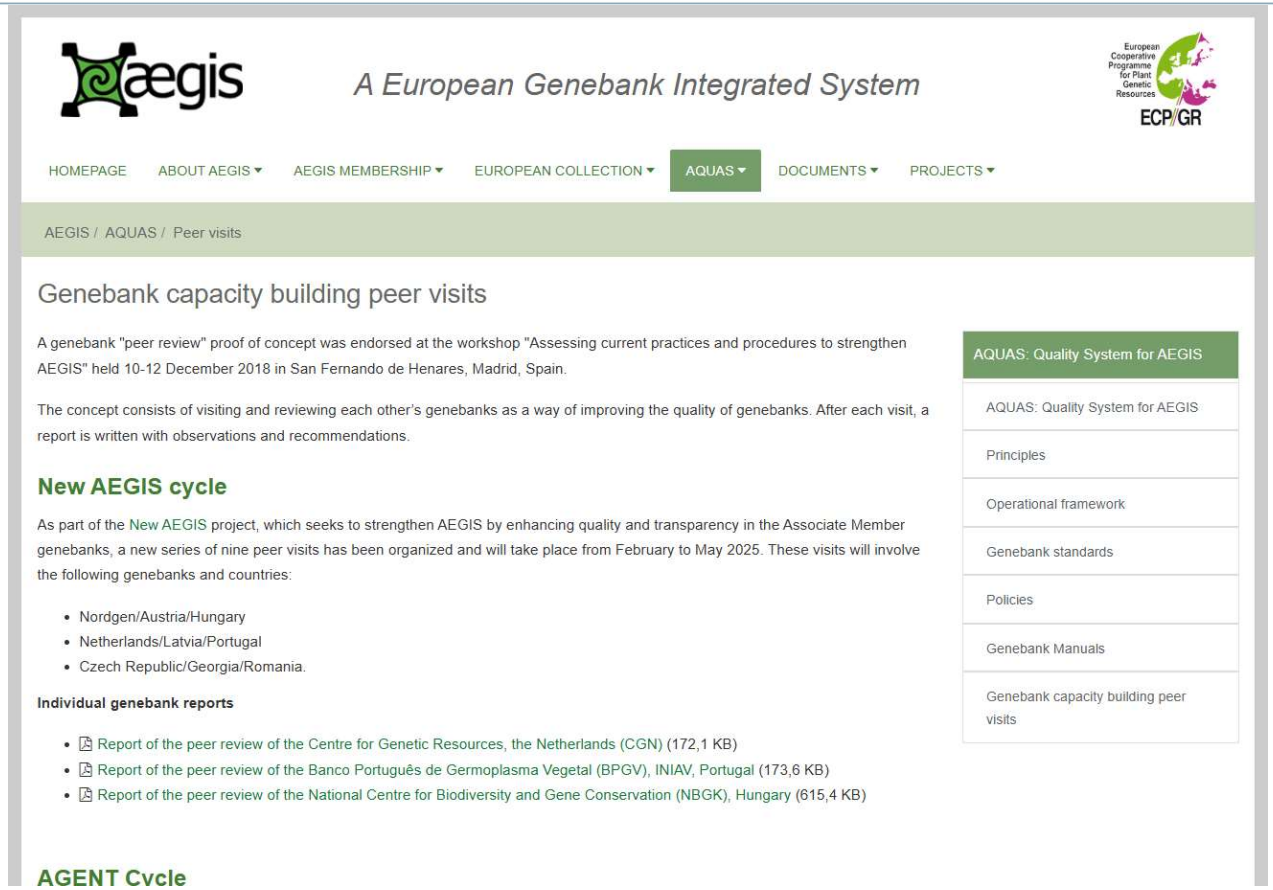
Improving Quality of European Genebanks

- activities aimed at quality improvement
  - genebank peer reviews
  - genebank metrics
  - genebank certification

Improving Quality of European Genebanks

- genebank peer reviews
  - concept: 3 genebanks visiting each other, learning from each other
    - 1x 3 genebanks in GenresBridge pilot cycle
    - 4x 3 genebanks in AGENT cycle
    - 3x 3 genebanks in New-AEGIS cycle
  - paper about first 5 cycles submitted to GR Journal
    - 17 authors of 11 genebanks
  - generally, very positive experiences

Improving Quality of European Genebanks



aegis

A European Genebank Integrated System

European Cooperative Programme for Plant Genetic Resources ECP/GR

HOMEPAGE | ABOUT AEGIS | AEGIS MEMBERSHIP | EUROPEAN COLLECTION | AQUAS | DOCUMENTS | PROJECTS

AEGIS / AQUAS / Peer visits

Genebank capacity building peer visits

A genebank "peer review" proof of concept was endorsed at the workshop "Assessing current practices and procedures to strengthen AEGIS" held 10-12 December 2018 in San Fernando de Henares, Madrid, Spain.

The concept consists of visiting and reviewing each other's genebanks as a way of improving the quality of genebanks. After each visit, a report is written with observations and recommendations.

New AEGIS cycle

As part of the New AEGIS project, which seeks to strengthen AEGIS by enhancing quality and transparency in the Associate Member genebanks, a new series of nine peer visits has been organized and will take place from February to May 2025. These visits will involve the following genebanks and countries:

- Nordgen/Austria/Hungary
- Netherlands/Latvia/Portugal
- Czech Republic/Georgia/Romania.

Individual genebank reports

- Report of the peer review of the Centre for Genetic Resources, the Netherlands (CGN) (172,1 KB)
- Report of the peer review of the Banco Português de Germoplasma Vegetal (BPGV), INIAV, Portugal (173,6 KB)
- Report of the peer review of the National Centre for Biodiversity and Gene Conservation (NBGK), Hungary (615,4 KB)

AGENT Cycle

AQUAS: Quality System for AEGIS

- AQUAS: Quality System for AEGIS
- Principles
- Operational framework
- Genebank standards
- Policies
- Genebank Manuals
- Genebank capacity building peer visits

Improving Quality of European Genebanks

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

Theo van Hintum [1*], Sharon Balding[2], Gergana Desheva[3], John Dickie[2], María José Díez[4], Luis Guasch[5], Pavol Hauptvogel[6], Vojtěch Holubec[7], Dagmar Janovská[7], Ulrike Lohwasser[8], Isaura Martín[5], Ludmila Papoušková[7], Beate Schierscher-Viret[9], Lise Lykke Steffensen[10], Katya Uzundzhalieva[3], Patrizia Vaccino[11] and José Vicente Valcárcel[4]

[1] Centre for Genetic Resources, The Netherlands (CGN), Wageningen University and Research (WUR), Wageningen, The Netherlands

[2] Millennium Seed Bank (MSB), Royal Botanic Gardens Kew, Wakehurst Place, Ardingly, UK

[3] Agricultural Academy, Institute of Plant Genetic Resources "Konstantin Malkov" (IPGR), Sadovo, Bulgaria

[4] Institute for the Conservation and Improvement of the Valentian Agrodiversity (COMAV), Polytechnic University of Valencia, Spain

[5] National Institute for Agricultural and Food Research and Technology (INIA-CSIC), Spanish Plant Genetic Resources Centre (CRF), Alcalá de Henares, Madrid, Spain

[6] Research Institute of Plant Production (RIPP), National Agricultural and Food Centre (NPPC), Piešťany, Slovakia

[7] Czech AgriFood Research Center (CARC), Ruzyně, Prague, Czech Republic

[8] Leibniz Institute of Plant Genetics and Crop Plant Research (IPK), Gatersleben, Germany

[9] AGROSCOPE, Changins, Nyon, Switzerland

[10] Nordic Genetic Resource Center (NordGen) Alnarp, Sweden

[11] Council for Agricultural Research and Economics (CREA), Research Center for Cereal and industrial Crops (CREA-CI), Vercelli, Italy

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. the wild

Improving Quality of European Genebanks

- genebank metrics
  - set of metrics to monitor genebank status and processes
    - builds on definitions and Standard Operating Procedures
    - basis for transparency and reporting
  - developed by CGN, tested and improved by ECPGR
    - special thanks to Filippo Guzon and New-AEGIS
  - paper submitted to PGRCU
    - 24 authors of 15 genebanks / organisations

Improving Quality of European Genebanks

3 apr 2025
Period 2020-2024

Cnr	Crop	# accessions	COMPOSITION																
			% wild/weedy	% landrace	% cultivar	% research mat.	% other/unkn.	% from NL	% from Asia	% from Africa	% from N. America	% from S. America	% from Europe	% from Oceania	% other/unkn.	time in coll.	# new 2020-2024	# out 2020-2024	
1	wheat	**4919**	10%	44%	27%	13%	6%	4%	39%	8%	3%	2%	39%	2%	7%	35.4	9	3	
2	barley	**2671**	3%	57%	17%	17%	6%	13%	45%	14%	2%	1%	31%	0%	6%	37.9	7	5	
3	flax	**954**	1%	5%	30%	48%	16%	6%	8%	2%	15%	10%	28%	1%	36%	25.6	3		
4	peas	**1039**	1%	33%	50%	8%	7%	24%	19%	9%	7%	1%	48%	2%	13%	34.1	30	1	
5	oat	**403**	2%	16%	52%	25%	4%	20%	2%	3%	10%	3%	73%	1%	7%	38.2	5	1	
6	lettuce	**2584**	41%	7%	47%	1%	4%	23%	22%	2%	4%	0%	61%	0%	10%	30.7	53	4	
7	cruciferae	**1803**	1%	18%	63%	9%	8%	35%	15%	10%	1%	0%	68%	0%	6%	33.8	10	2	
8	maize	**487**		59%	3%	4%	35%	3%	40%	0%	11%	1%	28%		21%	36.1			
12	faba beans	**724**		54%	32%	1%	12%	10%	28%	19%	3%	0%	43%	0%	7%	33.6	7	11	
14	lolium	**398**	13%	19%	57%		11%	73%	2%		1%		95%	1%	2%	28.1			
15	clover	**263**	58%	25%	15%	2%	0%	77%	12%		0%		84%		4%	30.9			
16	spinach	**541**	20%	23%	26%	1%	30%	22%	59%	1%	0%		32%		8%	27.4	34	5	
17	allium	**437**	10%	22%	58%	0%	8%	16%	22%	13%	6%		47%	2%	9%	25.6	6		
34	timothy	**108**	6%	6%	66%		21%	79%	5%	1%			92%		3%	29.9			
37	tomato	**1337**	8%	9%	60%	14%	9%	7%	7%	2%	27%	7%	40%	1%	17%	28.9			
38	pepper	**1177**	5%	30%	44%	2%	19%	6%	15%	5%	11%	12%	37%	1%	19%	23.1	36		
39	eggplant	**516**	5%	61%	18%	2%	15%	2%	52%	19%	5%		12%	0%	12%	25.2	6		
40	cucumber	**924**	0%	15%	40%	2%	43%	17%	31%	3%	14%	1%	46%	1%	5%	25.6		1	
41	potato	**1479**	85%	14%		0%	0%	0%			0%	83%	0%		17%	25.1	11		
42	meadow grass (P	**135**	42%		58%			99%			1%		99%			19.6			
50	carrot	**125**	77%	22%			2%	7%	88%	1%	2%		8%		2%	2.1	111		
	CGN collection	**23542**	16%	29%	35%	10%	10%	16%	26%	7%	6%	7%	43%	1%	11%	31.1	428	33	

crops with <200 accession were hidden

WAGENINGEN
UNIVERSITY & RESEARCH

Improving Quality of European Genebanks

Genebank metrics, an essential instrument for genebank management

Theo van Hintum[1*], Bela Bartha[2], Claudio Niggli[2], Alvina Avagyan[3], Sylvia Vogl[4], Lisa Achathaler[4], Vojtech Holubec[5], Ludmila Papouskova[5], Francesco Ferrari[6], Graziano Rossi[6], Attila Simon[7], Lajos Horváth Jr.[7], Renata Kowalik[8], Maja Boczkowka[8], Stephan Weise[9], Markus Opperman[9], Maarten van Zonneveld[10], Matija Obreza[11], Erik Wijnker[1], Noam Chayut[12], Fadia Chairi[13], Johan Axelsson[14], Lise Lykke Steffensen[14], Filippo Guzzon[15]

[1] Centre for Genetic Resources, The Netherlands (CGN), Wageningen University and Research (WUR), Wageningen, The Netherlands

[2] ProSpecieRara, Basel, Switzerland

[3] Scientific Centre of Vegetable and Industrial Crops, Darakert, Ararat Marz, Armenia

[4] Austrian Agency for Health and Food Safety, Linz, Austria

[5] Czech Agrifood Research Center, Prague, Czech Republic

[6] Department of Earth and Environmental Sciences, University of Pavia, Pavia, Italy

[7] National Centre for Biodiversity and Gene Conservation H-2766 Tápiószele, Külsőmező 15, Hungary

[8] Plant Breeding and Acclimatization Institute – National Research Institute (IHAR-PIB), National Centre for Plant Genetic Resources: Polish Genebank, Radzików, Poland

[9] Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) Gatersleben, Seeland, Germany

[10] World Vegetable Center, Shanhua, Taiwan

[11] Global Crop Diversity Trust, Bonn, Germany

[12] John Innes Centre, Norwich Research Park, Norwich, UK

[13] Walloon Centre of Agricultural Research, Libramont, Belgium

[14] NordGen Plants, Nordic Genetic Resource Center (NordGen), Alnarp, Sweden

[15] European Cooperative Programme for Plant Genetic Resources (ECPGR), c/o Alliance of Bioversity International and CIAT, Rome, Italy

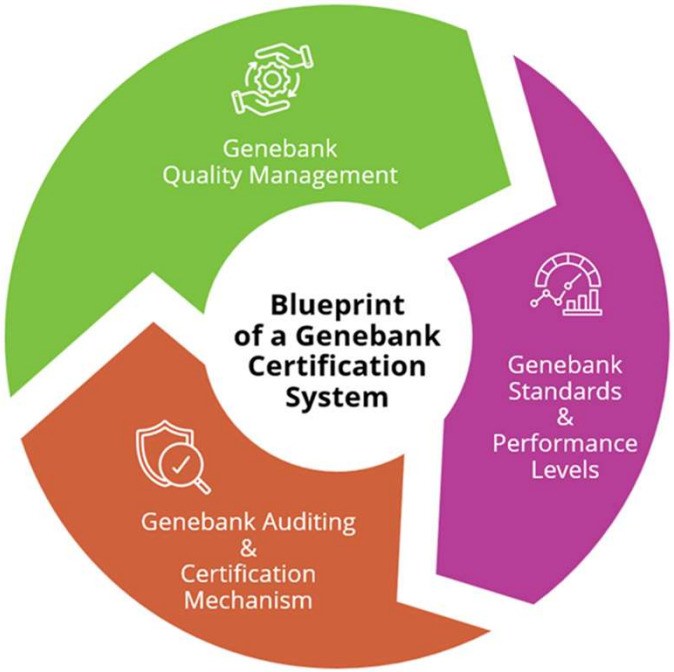
*Corresponding author: theo.vanhintum@wur.nl

Improving Quality of European Genebanks

- genebank certification
  - assure that PGR is available to current, and remains available for future generations
  - three elements are needed
    - agree on what procedures are good enough
      - community standards based on FAO Genebank Standards
    - manage quality in genebanks with QMS
      - ISO-9001 or GQMS
    - implement an auditing / certification system

Improving Quality of European Genebanks

- genebank certification
  - blueprint was written for Pro-Grace



Improving Quality of European Genebanks

- overall conclusions
  - genebank quality is an increasingly important topic in genebanks
  - current quality is often not sufficient to do our job (safely conserve and make available) and hinders collaboration
  - various developments are supporting improvements

Thank you for your attention !