PRO-GRACE
PROMOTING A PLANT GENETIC RESOURCE COMMUNITY FOR EUROPE

Funded by the European Union

How omics tools may support PGR management From identification to services

Michael Lyngkjær - NordGen

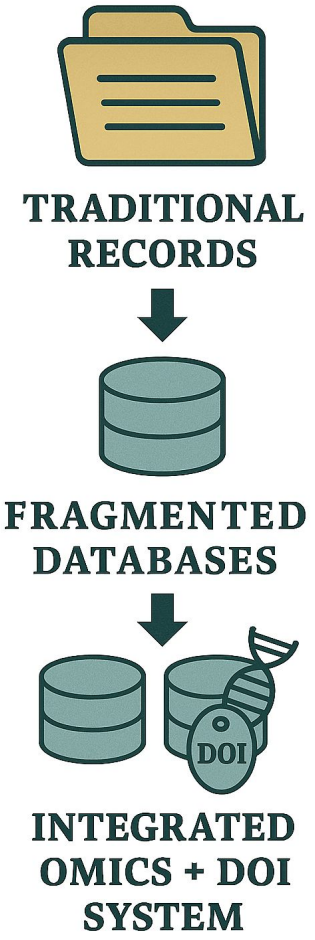
Pro-GRACE Final Project meeting

Chania 7 October 2025

NordGen

Introduction - *From documentation to data-driven management*

- **Traditional Identification**
  Challenge: Traditional PGR identification relies on passport data and taxonomy but suffers naming inconsistencies and human error
- **Genetic Resource Centers (GRCs)**
  GRCs manage ex situ, in situ, or integrated conservation of PGR
- **Global Information System and Persistent IDs**
  The GLIS system and DOI (Digital Object Identifier) standardize PGR data to reduce errors and duplication
- **Omics Technologies in Identification**
  Modern DNA barcoding and genotyping methods enable precise taxon and individual-level identification of plant genetic resources



Genetic identification of diverse PGR collections is challenging

- **Biological Diversity Challenges**

  PGR collections include pure lines, inbred cultivars, landraces, and wild materials with varied genetic structures

- **Sampling and Genotyping Issues**

  Simple DNA barcoding may miss variability, bulk DNA samples hide diversity while individual genotyping is resource-heavy

- **Technical and Data Complexities**

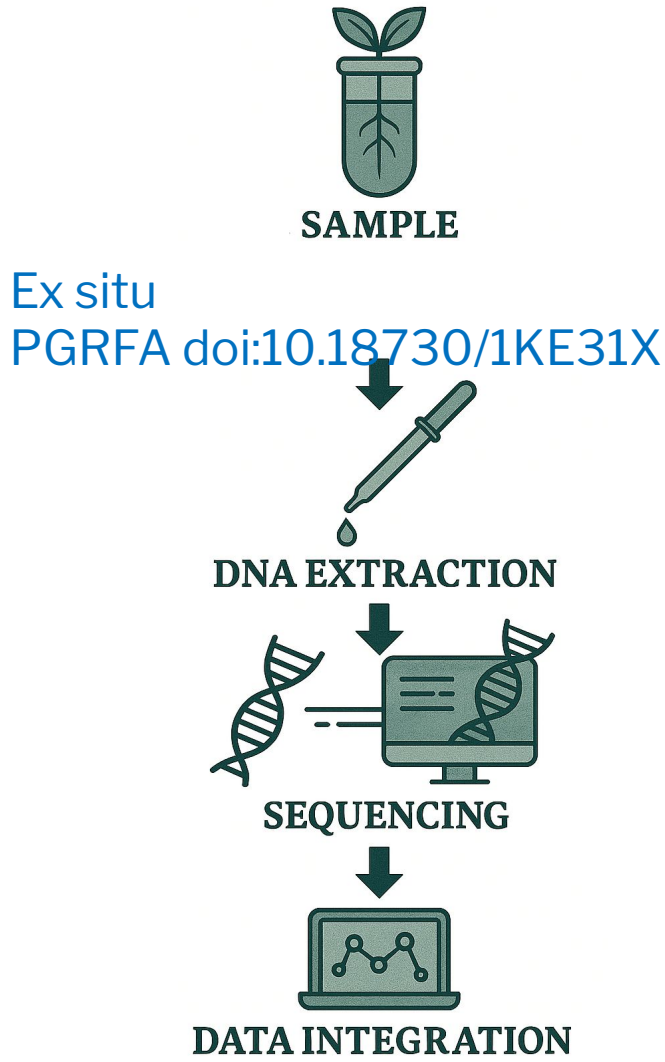
  Advanced methods require bioinformatics capacity, complicating alignment with inconsistent records

Need for unified digital and genetic ID strategies

- **Role of Digital Identifiers**
  DOIs provide global linkage and citation of material and data
- **Role of DNA Barcoding**
  DNA barcoding confirms biological identity and genetic profile, but requires digital linkage to connect with broader data
- **Need for Integrated Systems**
  Combining digital traceability with biological verification is essential for tracking and utilizing PGR effectively
- **GRACE-RI Initiative**

Workflow DOI assignment and DNA barcoding

1. Acquire accession & record passport data
2. Assign DOI
3. Perform DNA barcoding / sequencing
4. Deposit sequences in global repositories
5. Integrate into central PGR platform



Case Examples

- **Crop wild relatives**
  - *GRC/site manager assign IDs and use DNA barcodes to verify CWR taxonomy in situ*
  - *GRC/site manager register DOIs linking* in situ *populations to* ex situ *backup samples for traceability*
  - *Combining DOI and DNA data ensures conservation of CWR identity even after propagation or duplication*
- **On farm landraces**
  - *GRCs assign DOIs and use DNA barcoding to link genetic profiles to reference samples*
  - *Genetic linkage confirms landrace identity and uniqueness*
  - *DOI enables traceable sharing of landraces under SMTA*
- **Genebank accessions**
  - *Batch DOI registration standardizes accession data and improves cross-referencing*
  - *Barcoding libraries detect labeling errors and potential duplicate accessions*
  - *Genetic profiling and metadata reveal duplicates and enabling DOI cross-references*

Benefits in PGR Management

- **Accurate Identification**

  DNA-barcoding provide precise species and accession verification

- **Duplication Detection**

  Genetic profiles reveal redundant or mislabeled accessions across collections

- **Enhanced Traceability**

  Integration with DOIs links genetic and digital identifiers for transparent tracking

- **Data Interoperability**

  Shared omics and metadata standards connect GRCs, databases, and research systems

Beyond Identification – Services

- **Breeding Tools**
  - *Genomic data supports marker-assisted and genomic selection, GWAS, and trait discovery*
  - *Accelerates breeding for resilience, yield, and adaptation*
- **Compliance**
  - *Omics data and DOIs facilitate compliance with ITPGRFA and Nagoya Protocol*
  - *Enable traceable access and benefit-sharing documentation*
- **FAIR Data & Benefit Tracking**
  - *Integration with digital infrastructures enables FAIR (Findable, Accessible, Interoperable, Reusable) data*
  - *Ensures equitable sharing of PGR benefits*

Future Outlook

- From DNA barcoding to pangenomes & multi-omics
- Integration with phenomics, metabolomics, climate data
- Toward digital twins of PGR collections
- Support AI-driven breeding

Key Challenges

Cost & Access to Sequencing Facilities

- *Limited funding and infrastructure restrict large-scale genomics in many GRCs.*

Data Interoperability Gaps

- *Fragmented databases and incompatible formats limit data exchange - Need for standards*

Within-accession Heterogeneity

- *CWR & LR show high internal genetic diversity - Requires new sample and analysis strategies*

Policy Debates on Digital Sequence Information (DSI)

- *Uncertainty around access, benefit-sharing, and intellectual property rights*

Summary: Advancing PGR Management through Integrated Omics Tools in a GRACE-RI

Enhanced PGR Identification

Omics tools improve precise identification and characterization of plant genetic resources for better management.

Improved Traceability and Data Interoperability

Integrating DOIs ensures traceability and seamless exchange of PGR data across platforms and institutions.

Collaborative Conservation Efforts

Joint efforts in infrastructure, standards, and policy development promote sustainable PGR conservation and use.

PRO-GRACE
PROMOTING A PLANT GENETIC RESOURCE COMMUNITY FOR EUROPE

Funded by the European Union

THANK YOU

Michael Lyngkjær, NordGen
michael.Lyngkjær@nordgen.org
www.grace-ri.eu

Supported by the Horizon Europe programme, project number 101094738.