



Thematic Session 6

Evaluation and valorization of PGRs: facilitating their adoption in breeding programs.

Introduction

Veronique Lefebvre - INRAE
Ignazio Verde - CREA

HORIZON-INFRA-2022-DEV-01-01, n°101094738
January, 1st, **2023** –June, 30, **2025** (30 months)
<https://cordis.europa.eu/project/id/101094738>

Rationale

- To exploit the PGRs' potential we require a **well-organized system for the evaluation of their traits and agronomic characteristics.**
- **Increasing application of automated phenotyping systems: *portable sensors, image analysis, spectral imaging, drones, machine learning approaches.* Who can do a survey of the available systems and how to enlarge their applications?**
- **EVA (established by ECPGR and supported by EUROSEEDS) defined public/private partnerships for the characterization of field crop and vegetable PGR in multiple environments, with a focus on traits of interest for breeders. How to summarize results in a kind of database to help users to collect comparable dataset?**
- **ECPGR working groups have developed a series of crop-specific minimum descriptors based essentially on qualitative, or semi-quantitative features. Why not quantitative traits?**
- **MIAPPE, Crop ontology, planteome database have proposed minimum information, ontologies and data exchange/database formats to enhance FAIRness of phenotypic data. Check the crop-specific minimum descriptors, then do recommendations**
- **A distributed European RI on plant phenotyping (EMPHASIS) exists, based on controlled conditions, field phenotyping, modelling, and data and computational services. How to connect EMPHASIS RI with PRO-GRACE?**

Expected goals

- **To map and review the various initiatives**
- **To interconnect these various initiatives**
- **To establish a cooperation between the EMPHASIS RI, the various below actors*, and the final users**
- **To set agreed evaluation standards for *ex-situ* and *in-situ* PGR collections accessible through the EURISCO information system**

Actors

- *IPGRI: International Plant Genetic Resources Institute, supported by CGIAR*
- *EVA: European Evaluation Network*
- *ECPGR: European Cooperative Programme for Plant Genetic Resources*
- *MIAPPE: Minimum Information About Plant Phenotyping Experiments*
- *EMPHASIS: a RI that enables researchers to use facilities, resources and services for plant phenotyping across Europe*
- *EURISCO: European Search Catalogue for Plant Genetic Resources*
- *EUROSEEDS: “the voice of the European seed sector...”*
- *AGENT: Global Access to Plant Genetic Resources*

Deliverables

DLVB #	Description/Tasks	Due Date	Lead partner	Type and dissemination level
D4.1	Unified, crop-specific standards and protocols for the evaluation of the phenotypes and agronomic characteristics of PGR, incorporating the ECPGR, MIAPPE, Crop Ontology, EMPHASIS and final user recommendations and methodologies (version 1)	M11 Nov. 2023	INRAE P3	Public report
D4.2	Workshop on the evaluation of in situ and ex situ PGR collections , organized in collaboration with the EMPHASIS RI	M18 Jun. 2024	EUROS P13	Workshop and Public report
D4.3	Unified, crop-specific standards, protocols and descriptors for the evaluation of the phenotypes and agronomic characteristics of PGR, incorporating the ECPGR, MIAPPE, Crop Ontology EMPHASIS and final user recommendations and methodologies (version 2)	M24 Dec. 2024	CREA P15	Public report
D4.4	Interconnection of the different phenotype databases with the central EURISCO information system	M28 Apr. 2025	INRAE P3	Public DEC — Websites, patent filings, videos, etc

D4.1/D4.3 - Unified, crop-specific standards and protocols for the evaluation of the phenotypes and agronomic characteristics of PGR

version 1 = D4.1

Lead partner: INRAE, CREA

Due Date : Month 11 = Nov. 2023

version 2 = D4.3

Lead partner: CREA, INRAE

Due Date : Month 24 = Dec. 2024



Genebank Standards
for Plant Genetic Resources
for Food and Agriculture



Partners : ENEA, MAICH, IPGRI, NORDGEN, IPK, KIS, EUROS, CRI, UPV, INIAV, NBGK, CNR, RSR, RBGK, NASC, WORLDVEG

Link ~ WP1 – D1,1 – Standards for collecting and displaying phenotypic data and images – Month 11 = Nov. 2023

WP2 – D2,1 – Minimum quality standards for genebank operation – Month 11 = Nov. 2023

Cf. the FAO Genebank standards

- **4 crop groups** identified
- For each group: **traits important for breeding (e.g yield, resistance, quality etc)**
- Identify the minimum set of required **metadata describing the phenotypic experiment**
 - Which is the **minimum phenotypic dataset**: passports, phenotypes (MIAPPE), images ?

Examples from previous projects (e.g. the G2P-SOL pepper phenotypic kit)

- **Links with standards** from ECPGR, MIAPPE, Crop ontology, EMPHASIS; ELIXIR, AGENT

Who can help for D4.1/4.3 ?

Previous initiatives

- ECPGR: **Maria José Diez** UPV
- EMPHASIS: **Gabriele Bucci**, CNR, **Roland Pieruschka**, IBG
- EVA (IPGRI): **Sandra Goritschnig**, CGIAR, **Filipo Guzzon**, **Lorenzo Maggioni**
- MIAPPE, ELIXIR: **Michael Alaux**, INRAE, **Cyril Pommier**, INRAE
- EURISCO: **Stephan Weise** IPK, **Maria Antonietta Palombi** CREA

End-users

- Breeding companies :
 - **Nick Vangheluwe**, EUROSEEDS
- Plant genetic genebanks represented by a few institutes
 - INRAE, GAFL: **Rebecca Stevens**, **Véronique Lefebvre**
 - CREA: **Pasquale Tripodi**, **Patrizia Vaccino**, **Ignazio Verde**, **Maria Antonietta Palombi**; **Elisabetta Mazzucotelli**, **Elisa Vendramin**, **Sabrina Micali**
 - UPV: **Jaime Prohens**

Who else?

Identify crop groups and contact persons for developing crop-specific methods for crop evaluation

4 crop groups

- **Fruit trees:** Ignazio Verde (CREA), (?)
- **Fruit vegetables:** Veronique Lefebvre (INRAE), Maria Joes Diez (UPV) and Jaime Prohens (UPV)
- **Leafy vegetables:** Filippo Guzzon (CGIAR), (?)
- **Grains (cereals, pulses):** Filippo Guzzon (CGIAR), Patrizia Vaccino (CREA), Elisabetta Mazzucotelli (CREA)

First strategic objective for Novembre 2023

- **D4.1** : Develop crop-specific methods for crop evaluation, incorporating the ECPGR, MIAPPE, Crop ontology and EMPHASIS RI standards and protocols and the suggestions of the final users (breeders and seed companies).
 - Review and map all the existing initiatives relating to the 4 crop groups
 - 1th version (D4.1) **Terms (or Category) and Traits (qualitative and quantitative, discrete and continuous)**
 - Traits preferably those important for breeding
 - 2nd version (D4.3; December 2023) **methods and scales**
 - **Harmonization** of the existing initiatives

Prepare a multiple-entry table in which, for each crop group, we enumerate the characteristics that are important for evaluation

Prefer **characteristics important for breeding** rather than botanical or varietal classification such as DUS tests

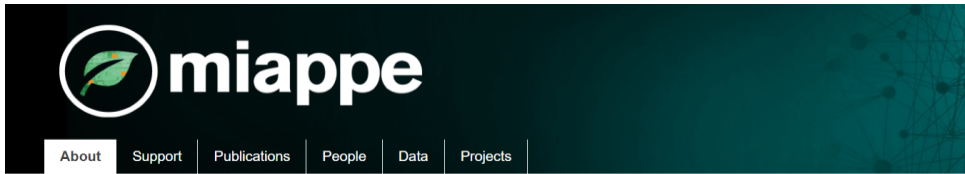
e.g.

- Yield
- Quality characteristics (before and after processing)
- Resistance to biotic stresses
- Tolerance to abiotic stresses
- Plant and root architecture
- Etc,

❖ Likely a table is not the ideal tool to summarize this work
→ Contributions from informatician are welcome

WP4. Evaluation and valorization

A series of initiatives such as the **Minimum Information about a Plant Phenotyping Experiment (MIAPPE)**, **Crop Ontology**, and the **Planteome database**, **EMPHASIS** have proposed minimum information, ontologies, and data exchange/database formats to enhance the **FAIRness of phenotypic data**.

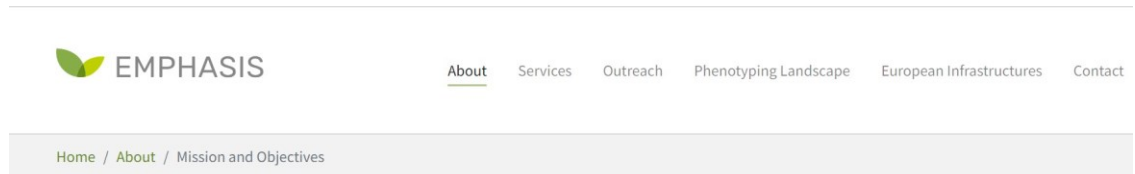


MIAPPE

Minimum Information About Plant Phenotyping Experiments

MIAPPE is an open, community driven, data standard designed to harmonize data from plant phenotyping experiments. MIAPPE provides a specification including a checklist and a data model of metadata required to adequately describe plant phenotyping experiments. You can have a quick [overview](#) or go to the primer section below. Those specifications are implemented in several tools, databases and file templates and exchange formats that allow to validate, store and disseminate MIAPPE-compliant data. We welcome contributions from anyone interested in plant phenotyping data, including linked data.

Development of MIAPPE is an open process, so if you would like to contribute by commenting, reviewing or participating to the ongoing development, please let us know via the MIAPPE mailing list.

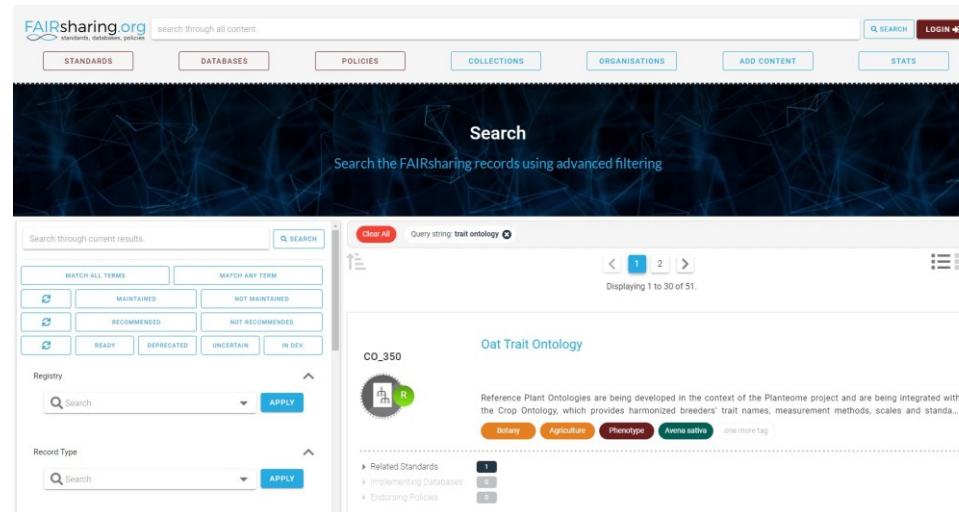


Plant Phenotyping
Mission and Objectives
e-Infrastructure
Infrastructure Categories
Development of projects
Preparatory Phase
Implementation Phase

EMPHASIS Roadmap

The European Strategy Forum for Research Infrastructures (**ESFRI**) has identified "Plant Phenotyping" as a priority for the European research area, and EMPHASIS has been listed on the **ESFRI Roadmap 2016 for Research Infrastructures** as an infrastructure project to develop and implement a pan-European plant phenotyping infrastructure.

The European Union is funding a four-year-long project called EMPHASIS-PREP in order to bring EMPHASIS to the level of legal, financial and technical maturity required for full implementation. With the kick-off of EMPHASIS-PREP on 1 January 2017, EMPHASIS has entered the **Preparatory Phase**.



Deliverable n. 4.1

How to organize the existing Initiatives? For which use? For who?

Warning: We are revising the site so new uploads are not currently possible. Please contact us if you really need to upload a TD.

You can register on the [CoP Social Network](#) to participate to discussions!

Watch the [webinar](#) about the use of CO in Breeding Management Systems (IBP/BMS, Breedbase)

Instructions for developing a new ontology or submit new traits to an existing crop are in the 'Guidelines' menu.

Search

Ontology name	Ontology description	Type
Apple Created on Tuesday 23rd of August, 2022, 13:13:30 53 variables	Apple (Malus domestica) defines crop traits and variables to support the standardisation of apple breeding databases providing description of agronomic, morphological, physiological, quality traits, its methods and scales.	Trait
Bambara groundnut Created on Friday 29th of December, 2019, 08:42:44 163 variables	version Dec 2019	Trait
Banana Created on Thursday 18th of April, 2019, 10:45:39 390 variables	Banana Trait Dictionary in template 5 - Bioversity & IITA - April 2019	Trait

GDR Species - Data - Search - Tools - General - Help - Community - Login Search

Rosaceae Trait Ontology

GDR has made an effort to standardize the trait names and the abbreviations for all the trait data entered in the database. GDR QTL are associated with these trait terms and QTL labels, assigned by GDR, use the below abbreviations for the listed traits. Each of these trait terms is either an existing term or a child term of the existing term of the plant trait ontology. One trait term can belong to multiple Root TO term. When possible, we have used abbreviations that are consistent with established trait or crop ontologies. Where new ones were developed they have been submitted to the Trait Ontology consortium for inclusion. We would appreciate if new studies could use these standardized terms where possible. If you have a new trait or are unsure about the naming please **contact us**.

To see all the traits, click to expand the trait category below. Or narrow the list using the keyword search.

Keyword Search

Category	Count
+ biochemical trait	155
+ plant growth and development trait	56
+ plant morphology trait	215
+ quality trait	94
+ stature or vigor trait	14
+ sterility or fertility trait	6
+ stress trait	37
+ yield trait	5

GDR Species - Data - Search - Tools - General - Help - Community - Login Search

Rosaceae Trait Ontology

GDR has made an effort to standardize the trait names and the abbreviations for all the trait data entered in the database. GDR QTL are associated with these trait terms and QTL labels, assigned by GDR, use the below abbreviations for the listed traits. Each of these trait terms is either an existing term or a child term of the existing term of the plant trait ontology. One trait term can belong to multiple Root TO term. When possible, we have used abbreviations that are consistent with established trait or crop ontologies. Where new ones were developed they have been submitted to the Trait Ontology consortium for inclusion. We would appreciate if new studies could use these standardized terms where possible. If you have a new trait or are unsure about the naming please **contact us**.

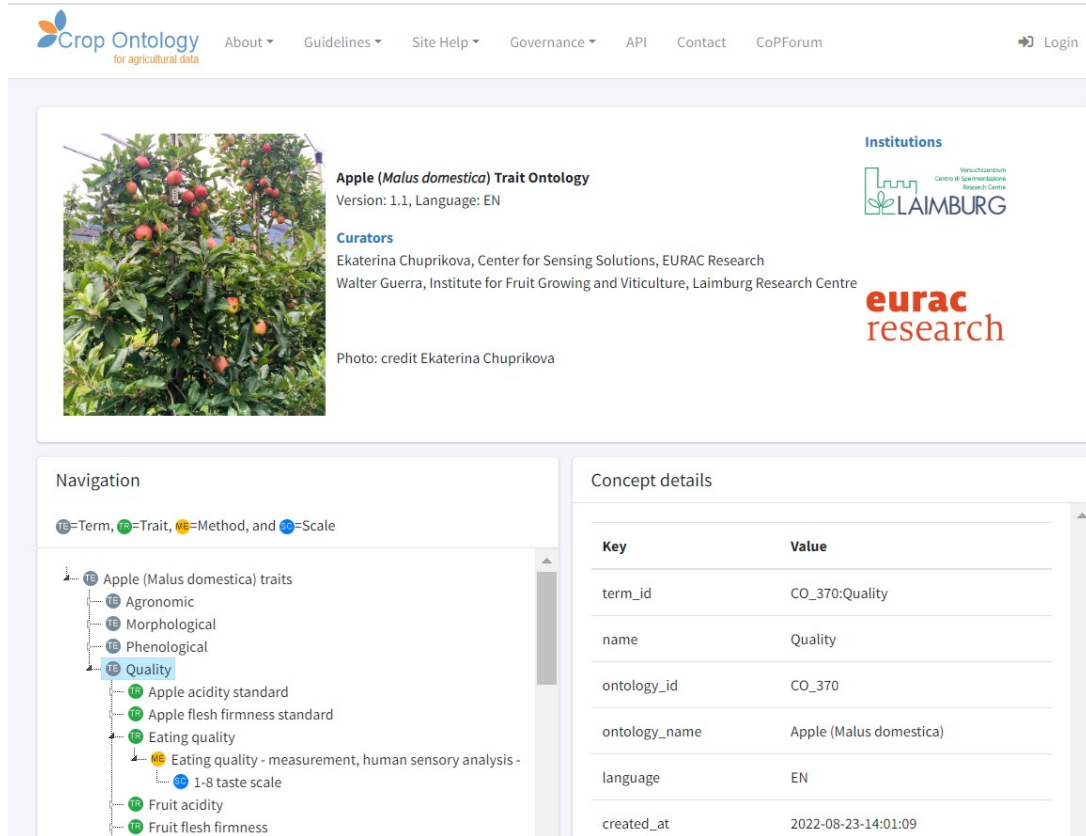
To see all the traits, click to expand the trait category below. Or narrow the list using the keyword search.

Keyword Search

Category	Abbreviation	Trait Name	Definition	Count
+ biochemical trait				155
+ plant growth and development trait				56
+ plant morphology trait				215
- quality trait	ASA	L-Ascorbic acid content	amount of L-ascorbic acid in fruit	94
	ATCL	anther color	color of anther	
	BTPT	bitter pit	pitting of the cortical flesh	
	CAPPING	ease of calyx removal	Ease of calyx removal	
	CITA	citric acid content	amount of citric acid n fruits	
	DMC	dry matter content	dry matter content	
	EATQUALITY	eating quality	A combined assessment of flavour, acidity, sweetness, aroma and astringency at optimum eating time	
	FD	flowering date	The date in May when the first flower opened	
	FDP	fruit development period	number of days between blooming and maturity dates	

Deliverable n. 4.1

Crop Ontology: Examples



Crop Ontology for agricultural data

About ▾ Guidelines ▾ Site Help ▾ Governance ▾ API Contact CoPForum Login

Apple (*Malus domestica*) Trait Ontology
Version: 1.1, Language: EN

Institutions
LAIMBURG
eurac research

Curators
Ekaterina Chuprikova, Center for Sensing Solutions, EURAC Research
Walter Guerra, Institute for Fruit Growing and Viticulture, Laimburg Research Centre

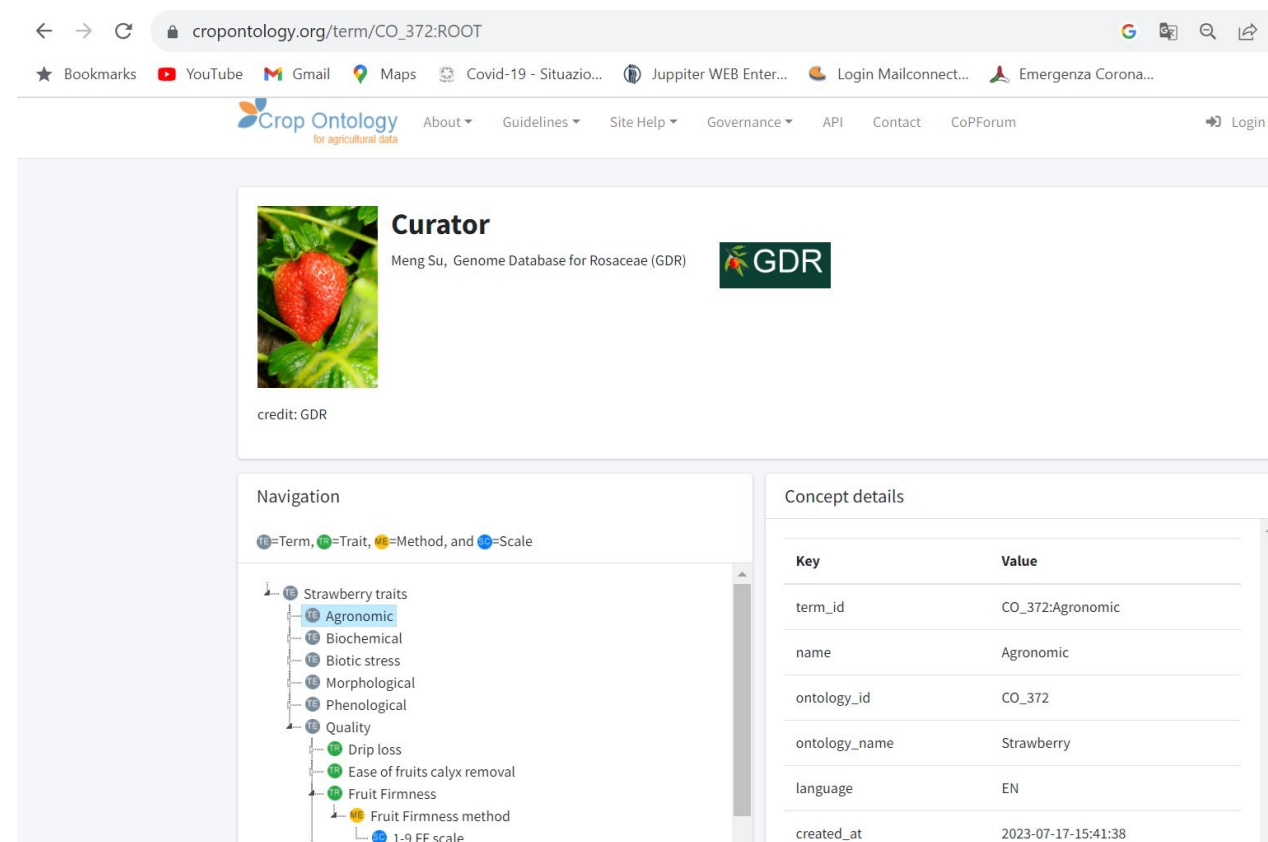
Photo: credit Ekaterina Chuprikova

Navigation
Term, Trait, Method, and Scale

- Apple (*Malus domestica*) traits
 - Agronomic
 - Morphological
 - Phenological
 - Quality
 - Apple acidity standard
 - Apple flesh firmness standard
 - Eating quality
 - Eating quality - measurement, human sensory analysis -
 - 1-8 taste scale
 - Fruit acidity
 - Fruit flesh firmness

Concept details

Key	Value
term_id	CO_370:Quality
name	Quality
ontology_id	CO_370
ontology_name	Apple (<i>Malus domestica</i>)
language	EN
created_at	2022-08-23-14:01:09



Crop Ontology for agricultural data

About ▾ Guidelines ▾ Site Help ▾ Governance ▾ API Contact CoPForum Login

← → ↻ cropontology.org/term/CO_372:ROOT

★ Bookmarks YouTube Gmail Maps Covid-19 - Situazio... Jupyter WEB Enter... Login Mailconnect... Emergenza Corona...

Curator
Meng Su, Genome Database for Rosaceae (GDR)

credit: GDR

Navigation
Term, Trait, Method, and Scale

- Strawberry traits
 - Agronomic
 - Biochemical
 - Biotic stress
 - Morphological
 - Phenological
 - Quality
 - Drip loss
 - Ease of fruits calyx removal
 - Fruit Firmness
 - Fruit Firmness method
 - 1-9 FF scale

Concept details

Key	Value
term_id	CO_372:Agonomic
name	Agonomic
ontology_id	CO_372
ontology_name	Strawberry
language	EN
created_at	2023-07-17-15:41:38

Integrate a methodology for measuring characteristics (for D4.3)

Types of descriptor, methods and scales

★ Qualitative

- Binary (0; 1)
- Sequential (vigor, e.g 1-9)
- Not sequential (e.g colors; more than 2)

★ Quantitative

- Discrete (e.g number of seeds)
- Continuous (e.g Plant height)

Integrate information from other initiatives (ECPGR, EVA, MIAPPE, EMPHASIS, etc.) (D4.3)

The final report of these two deliverables (D4.1 and D4.3) should be a **Review Position Paper** involving PRO-GRACE participants and other RI's and EU projects such as:

EMPHASIS

ELIXIR

MIAPPE

AGENT

EVA (IPGRI)

ECPGR

EURISCO

Etc.



**Thanks for
your attention.**