FAIR Plant Phenomics Data Management Tools and Guidelines

Some current practices in Elixir and Emphasis European Infrastructures

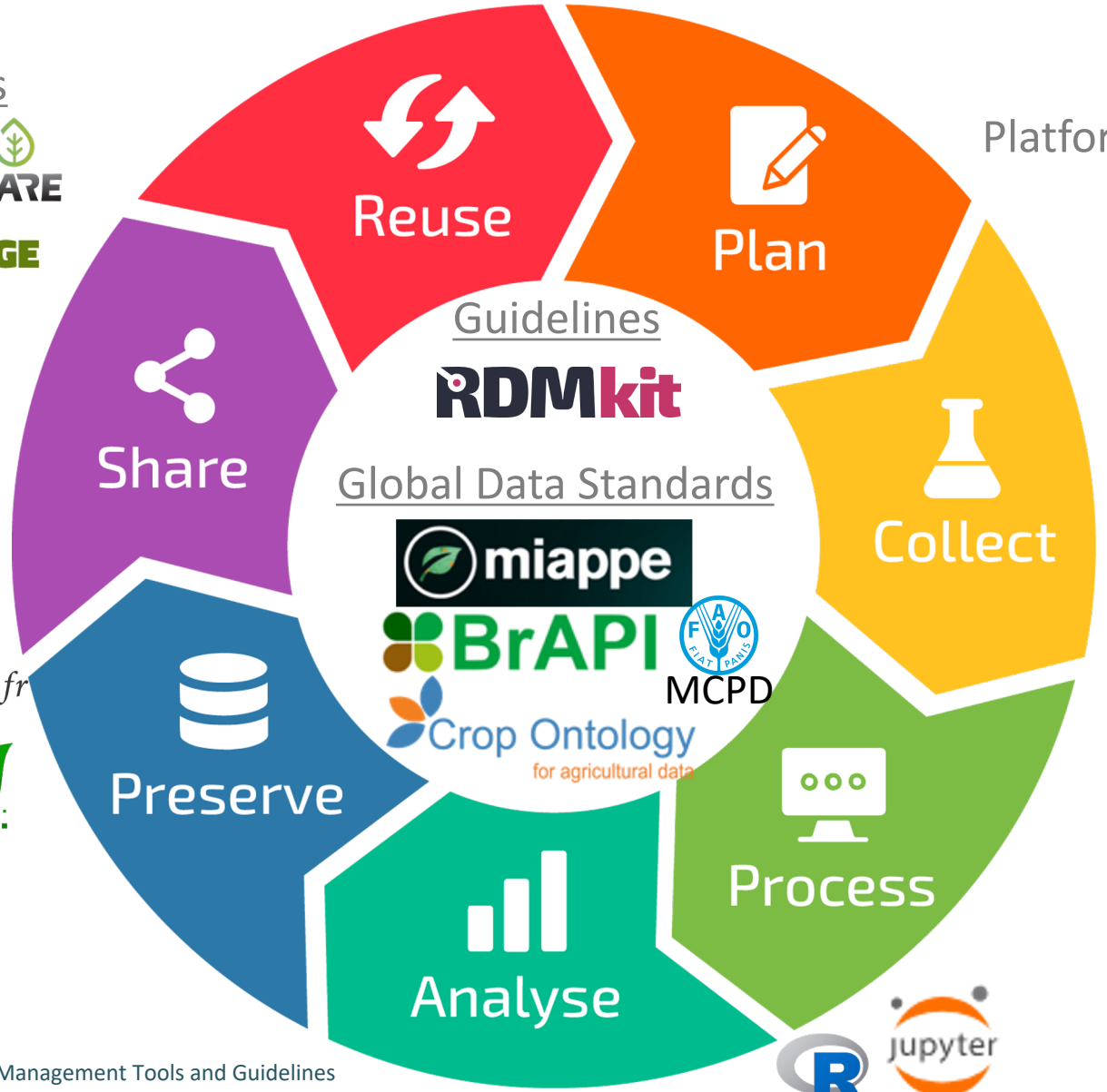
RÉPUBLIQUE FRANÇAISE
Liberté Égalité Fraternité

INRAE

www.elixir-europe.org

https://emphasis.plant-phenotyping.eu

Overview



Data portals

FAIDARE

FLORILÈGE

Data repositories

The Dataverse Project

recherche.data.gouv.fr

zenodo

EMBL-EBI

PHIS

Platform Information Systems

GRIN-Global

Outil Local de Gestion des Accessions

PHIS

PIPPA

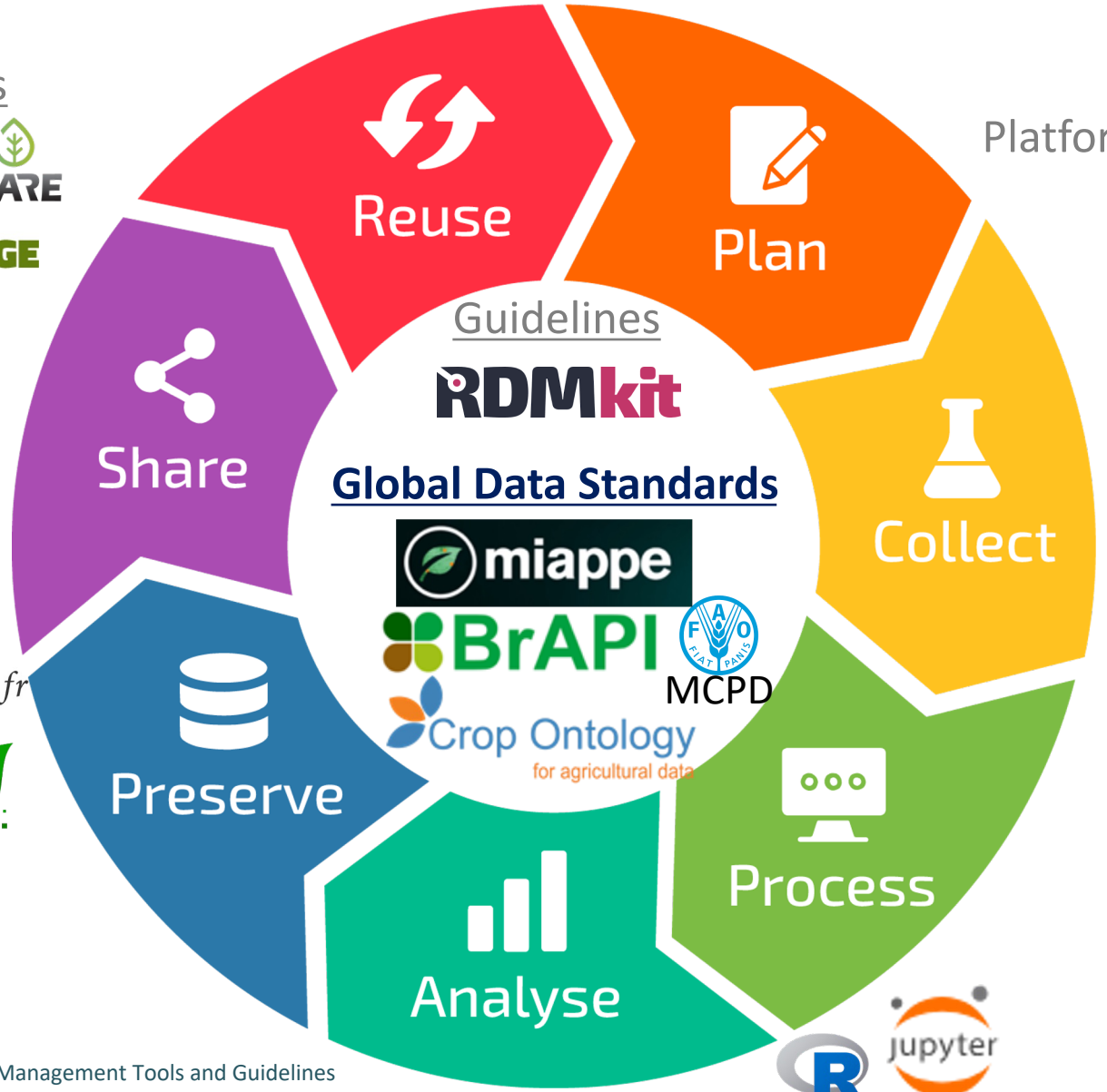
Portable devices, sensors, …

Scripts and Workflows

R

jupyter

Overview



Data portals

FAIDARE

FLORILÈGE

Data repositories

The Dataverse Project

recherche.data.gouv.fr

zenodo

EMBL-EBI

PHIS

Platform Information Systems

GRIN-Global

Outil Local de Gestion des Accessions

PHIS

PIPPA

Portable devices, sensors, …

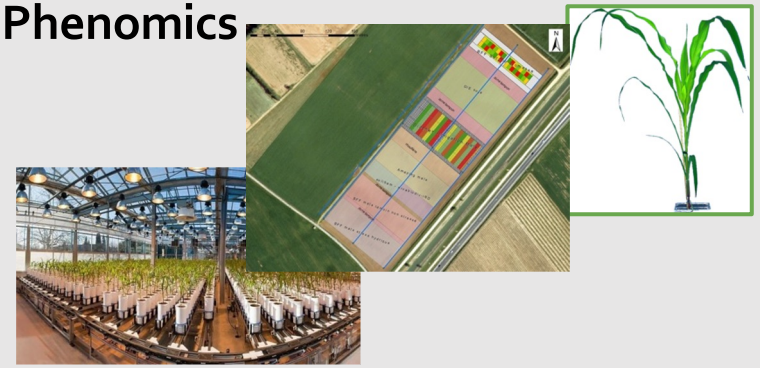
Scripts and Workflows

R

jupyter

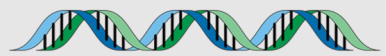
Scope: Phenotype to genotype integration and management

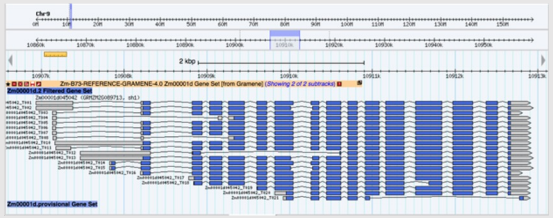
Phenomics



Findable Accessible Interoperable Reusable

Genetics
Genomics
Omics





Plant Breeding
Genetic variations by Traits

Climate Change Studies
Genotype by Environment

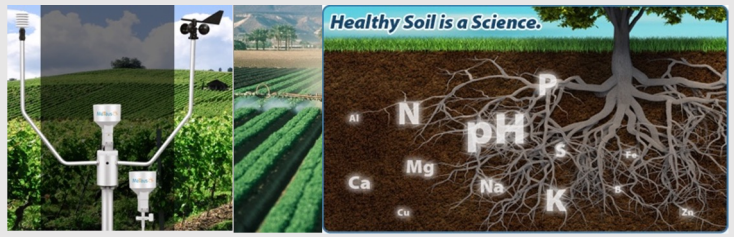
Dispersed (no central repo)
Heterogenous
Getting Standardized

Mostly centralized
Homogenous data
Heterogenous metadata

Findable Accessible Interoperable Reusable

Environment

Dispersed
Heterogenous

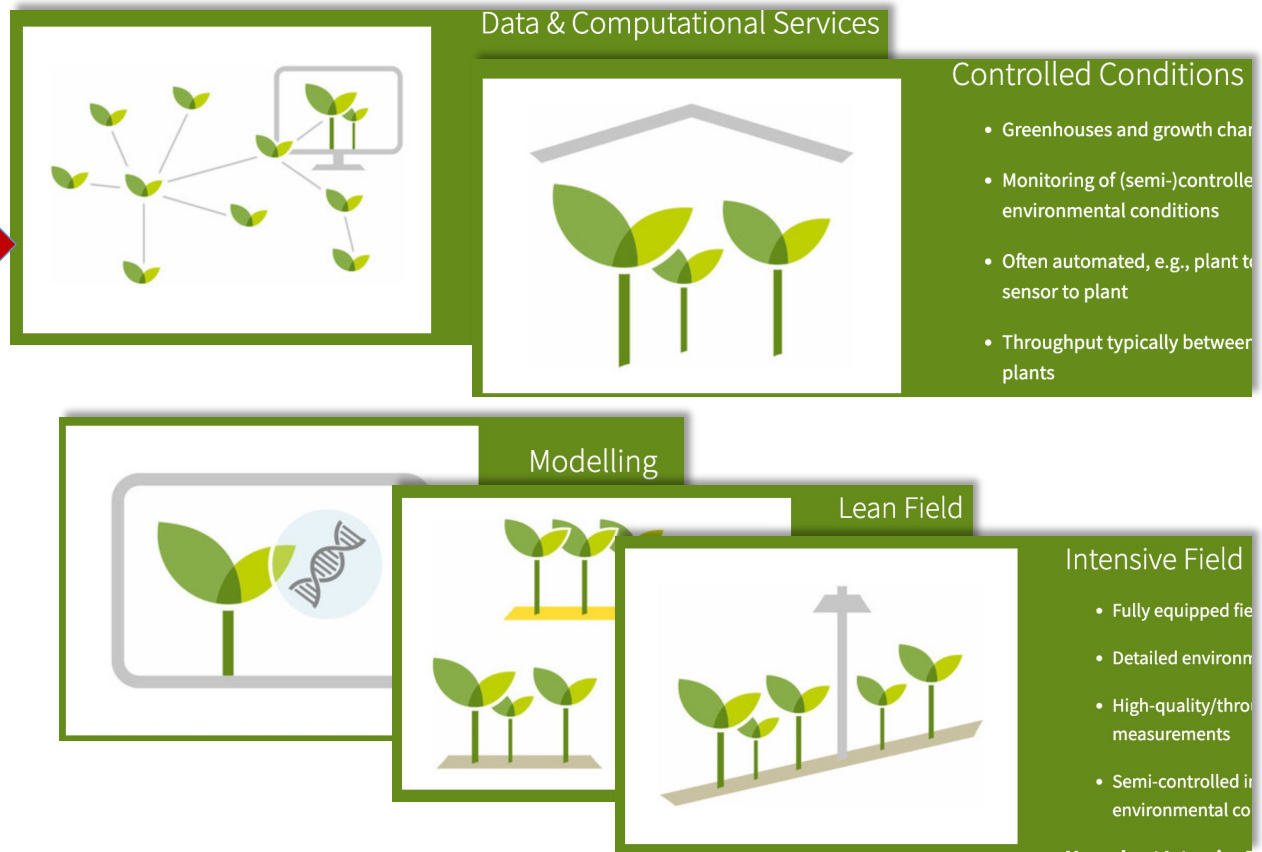


Plant data standards: involved EU research infrastructures

Gathered to solve Pheno to Omic data management and integration

- ELIXIR
  - European Infrastructure for life sciences data
  - Slovenia , France, Germany, Portugal, UK, Belgium, Italy, Nl…
  - https://elixir-europe.org/communities/plant-sciences
  - FAIR data management, software, training, …

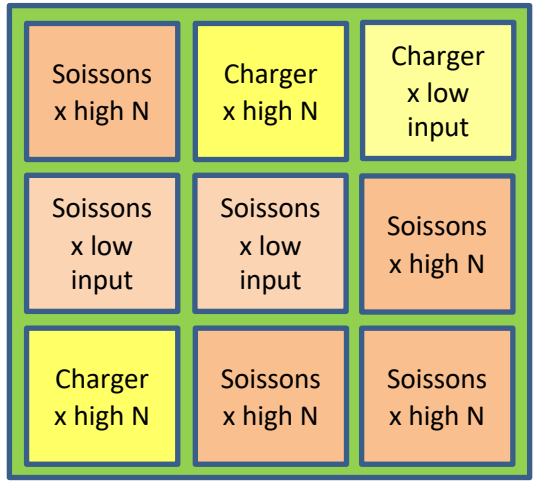
- EMPHASIS
  - European Infrastructure for Plant Phenotyping
  - France, Germany, Belgium, UK, …
  - https://www.plant-phenotyping.eu



Data lifecycle: many types of phenotypes datasets

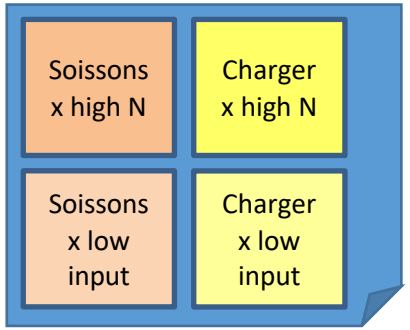
Data Acquisition → Data computation/Integration

« Raw » data, pheno/env measurement, variables



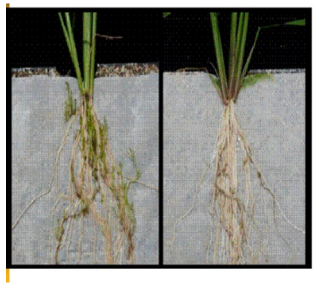
Derivation, Reduction

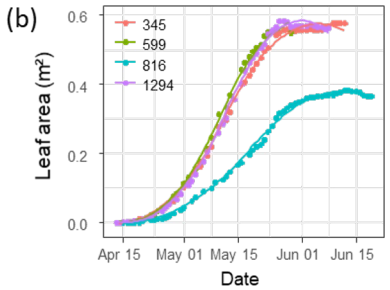
« Derived» data, indicators



Genotype	Treatment	N input	Date	Rep	Fusariose
Soissons	low input	15,3225129	15/11/2011	1	5
Soissons	low input	15,3430556	16/11/2011	2	7

Genotype	Treatment	Fusariose
Soissons	low input	6

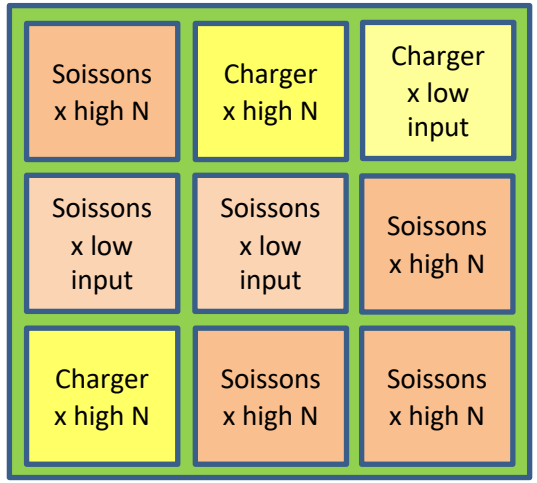




Data lifecycle: many types of phenotypes datasets

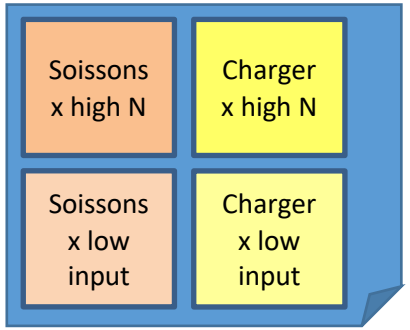
Data Acquisition → Data computation/Integration → Knowledge

« Raw » data, pheno/env measurement, variables

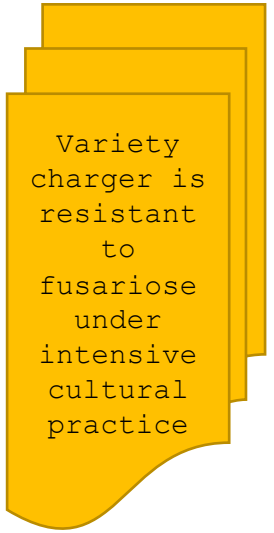


Derivation, Reduction

« Derived» data, indicators

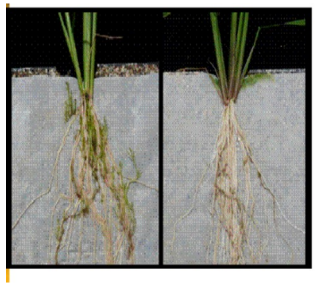


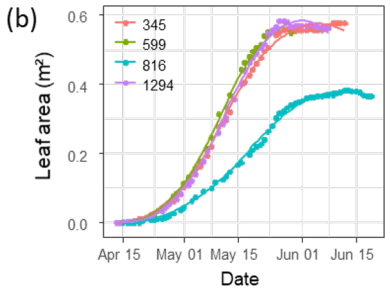
Publication

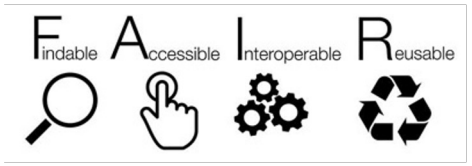


Genotype	Treatment	N input	Date	Rep	Fusariose
Soissons	low input	15,3225129	15/11/2011	1	5
Soissons	low input	15,3430556	16/11/2011	2	7

Genotype	Treatment	Fusariose
Soissons	low input	6





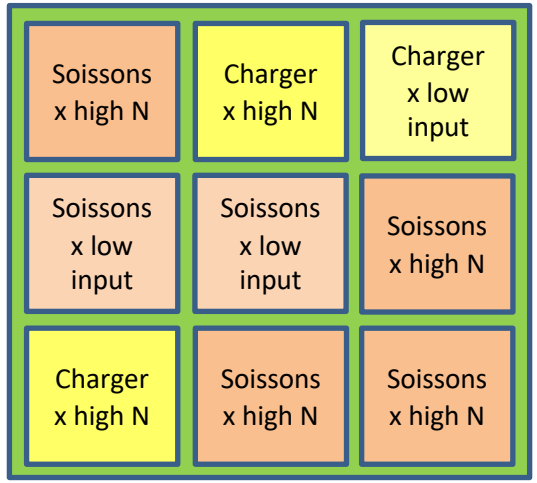


Wilkinson et al.
The FAIR Guiding Principles for scientific data management and stewardship.
Scientific Data 3 (2016)

Data lifecycle: many types of phenotypes datasets

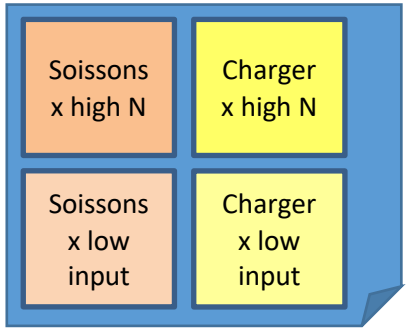
Data Acquisition → Data computation/Integration → Knowledge

« Raw » data, pheno/env measurement, variables

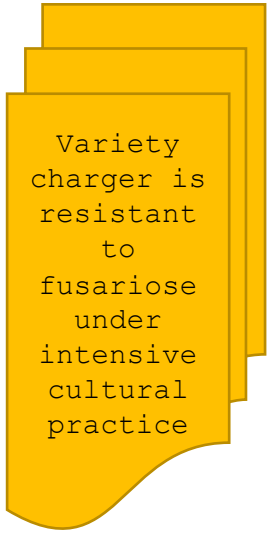


Derivation, Reduction

« Derived» data, indicators



Publication



Genotype	Treatment	N input	Date	Rep	Fusariose
Soissons	low input	15,3225129	15/11/2011	1	5
Soissons	low input	15,3430556	16/11/2011	2	7

Genotype	Treatment	Fusariose
Soissons	low input	6

VARIABLES

- Raw Measures Pheno & Env
- Data cleaning
- Traceability, Reproducibility & Provenance

INDICATORS

- New computation for each scientific question
- One experimental dataset → many derived dataset

Raw data long term conservation

Plant Data standards

Semantic

- Description of the data
- Controlled vocabularies: term name and definitions
- Ontologies: semantic links between terms
- *Biologist* driven

Structure

- Formatting and Organizing the data
- Data Models
- Standards : CSV, VCF, GFF, MIAPPE (www.miappe.org) , etc…
- *Biologist & Computer scientist* driven

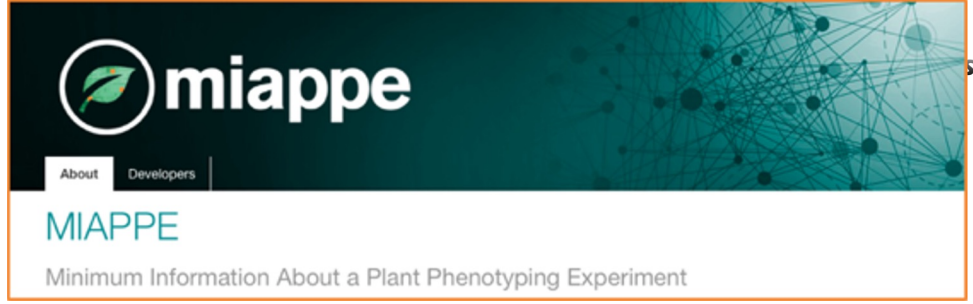
Persistent Unique Identifiers
DOI, URI, gene ID, accessions ID, Trait ID, …

Technical

- Data integration and sharing
- Interoperability : tools and systems
  - GA4GH
  - Breeding API www.brapi.org
  - Computer scientist driven

Phenotype Structure Standard

Minimal Information About Plant Phenotyping Experiments

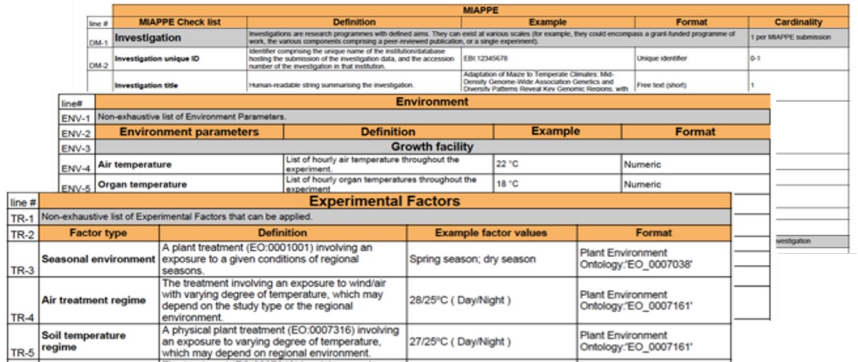


- www.miappe.org
- Crops and woody plants
- Single experiment
- Multilocal multiyear network
- Field
- Greenhouse
- Many stakeholders
  - Elixir, Emphasis, Bioversity CGIAR, North American PPN
- Open Community
  - Request for comments
  - Github Feature requests
  - Mailing lists
  - Meetings & Workgroups

Version 1
- 2015
- Initial Checklist

Version 1.1
- 2019
- Data model formalisation

Version 1.2
- 2024
- Minor additions
- **RFC opens in January → shared through the mailing list**

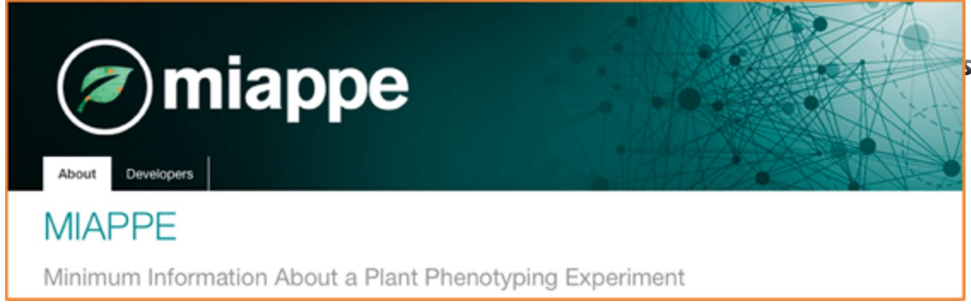


MIAPPE				
line #	MIAPPE Check list	Definition	Example	Format	Cardinality
DM-1	Investigation	Investigations are research programmes with defined aims. They can exist at various scales (for example, they could encompass a grant-funded programme of work, the various components comprising a peer-reviewed publication, or a single experiment).			1 per MIAPPE submission
DM-2	Investigation unique ID	identifier comprising the unique name of the institution/database hosting the submission of the investigation data, and the accession number of the investigation in that institution.	EBI:12345678	Unique identifier	0-1
	Investigation title	Human-readable string summarising the investigation.	Adaptation of Maize to Temperate Climates: Mid-Density Genome-Wide Association Genetics and Diversity Patterns Reveal Key Genomic Regions, with	Free text (short)	1

Environment			
line#			
ENV-1	Non-exhaustive list of Environment Parameters.		
ENV-2	Environment parameters	Definition	Example	Format
ENV-3	Growth facility			
ENV-4	Air temperature	List of hourly air temperature throughout the experiment.	22 °C	Numeric
ENV-5	Organ temperature	List of hourly organ temperatures throughout the experiment	18 °C	Numeric

Experimental Factors				
line #				
TR-1	Non-exhaustive list of Experimental Factors that can be applied.			
TR-2	Factor type	Definition	Example factor values	Format
TR-3	Seasonal environment	A plant treatment (EO:0001001) involving an exposure to a given conditions of regional seasons.	Spring season; dry season	Plant Environment Ontology:'EO_0007038'
TR-4	Air treatment regime	The treatment involving an exposure to wind/air with varying degree of temperature, which may depend on the study type or the regional environment.	28/25°C (Day/Night)	Plant Environment Ontology:'EO_0007161'
TR-5	Soil temperature regime	A physical plant treatment (EO:0007316) involving an exposure to varying degree of temperature, which may depend on regional environment.	27/25°C (Day/Night)	Plant Environment Ontology:'EO_0007161'

• Phenotype Structure Standard



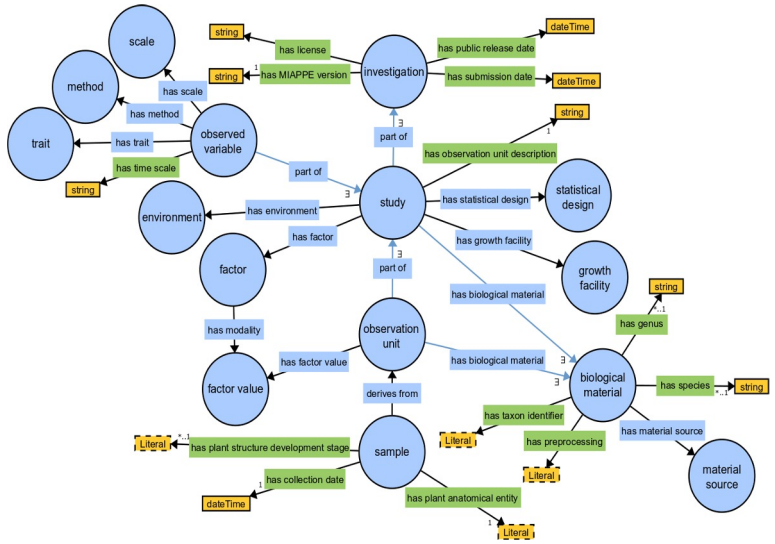
Minimum Information for Biological and Biomedical Investigations

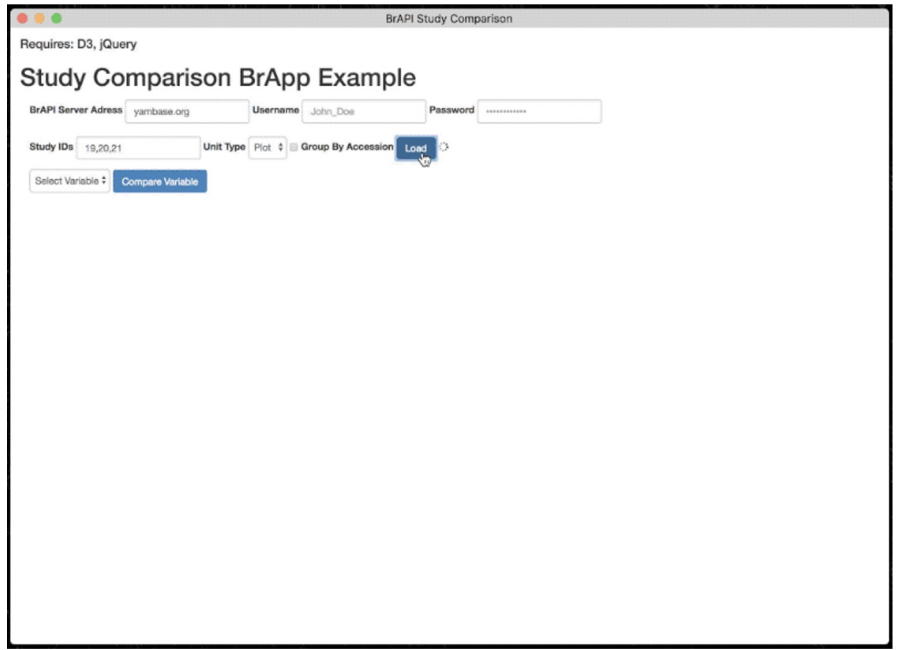
A collection of the historical MIBBI foundry reporting guidelines. The minimum information standard is a set of guidelines for reporting data derived by relevant methods in biosciences. If followed, it ensures that the data can be easily verified, analysed and clearly

- Biologist Friendly
  - Clear definitions and examples
  - Excel templates
  - Trainings
- Computer scientist friendly
  - Model, implementations, formalisation
- Minimal and sufficient list of metadata:
  - The objective of the experiment
  - Who contributed to the experiment
  - What were the experimental procedures
  - What was the biological material experimented
  - …

Phenotype Technical Standard, MIAPPE Implementations

- Ontology, OWL Implementation
  - https://github.com/MIAPPE/MIAPPE-ontology
  - http://agroportal.lirmm.fr/ontologies/PPEO
  - Data model representation
  - Formal concepts and constraints
- File Archive
  - ISA Tab: data + metadata
  - RO Crate
  - Template Excel
- Web Services
  - Breeding API
  - International collaboration
  - Standard Open Web Service API
  - Information Exchange, Main target: Breeding
  - Excellence in Breeding platform (CGIAR, Peter
- Data repositories
  - Any BrAPI compliant DB (GnpIS, PHIS, PIPPA, …)
  - Generic data repositories (Dataverse, Zenodo, e!Dale, …)





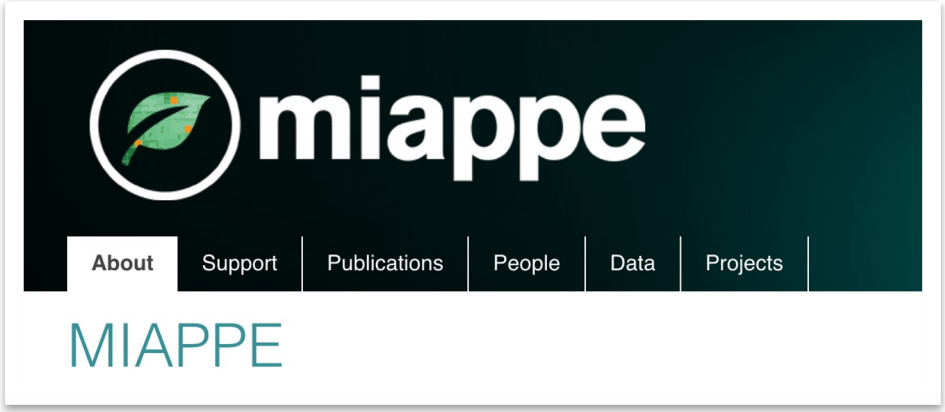
• MIAPPE Specifications

- www.miappe.org

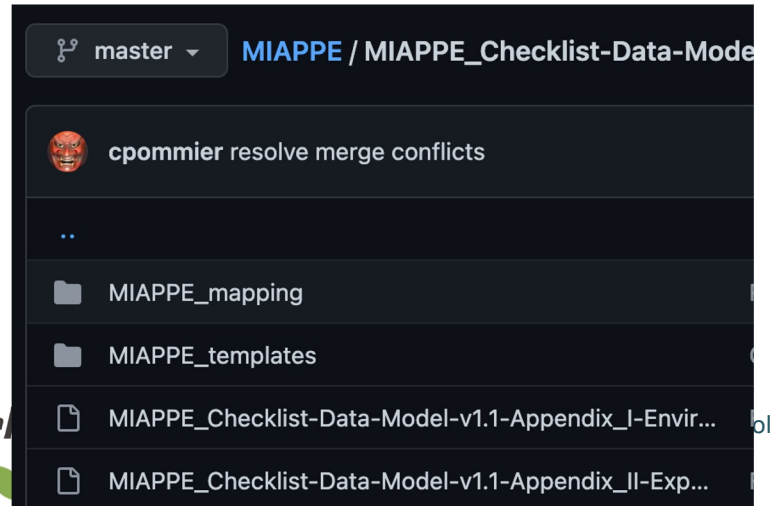
MIAPPE primers

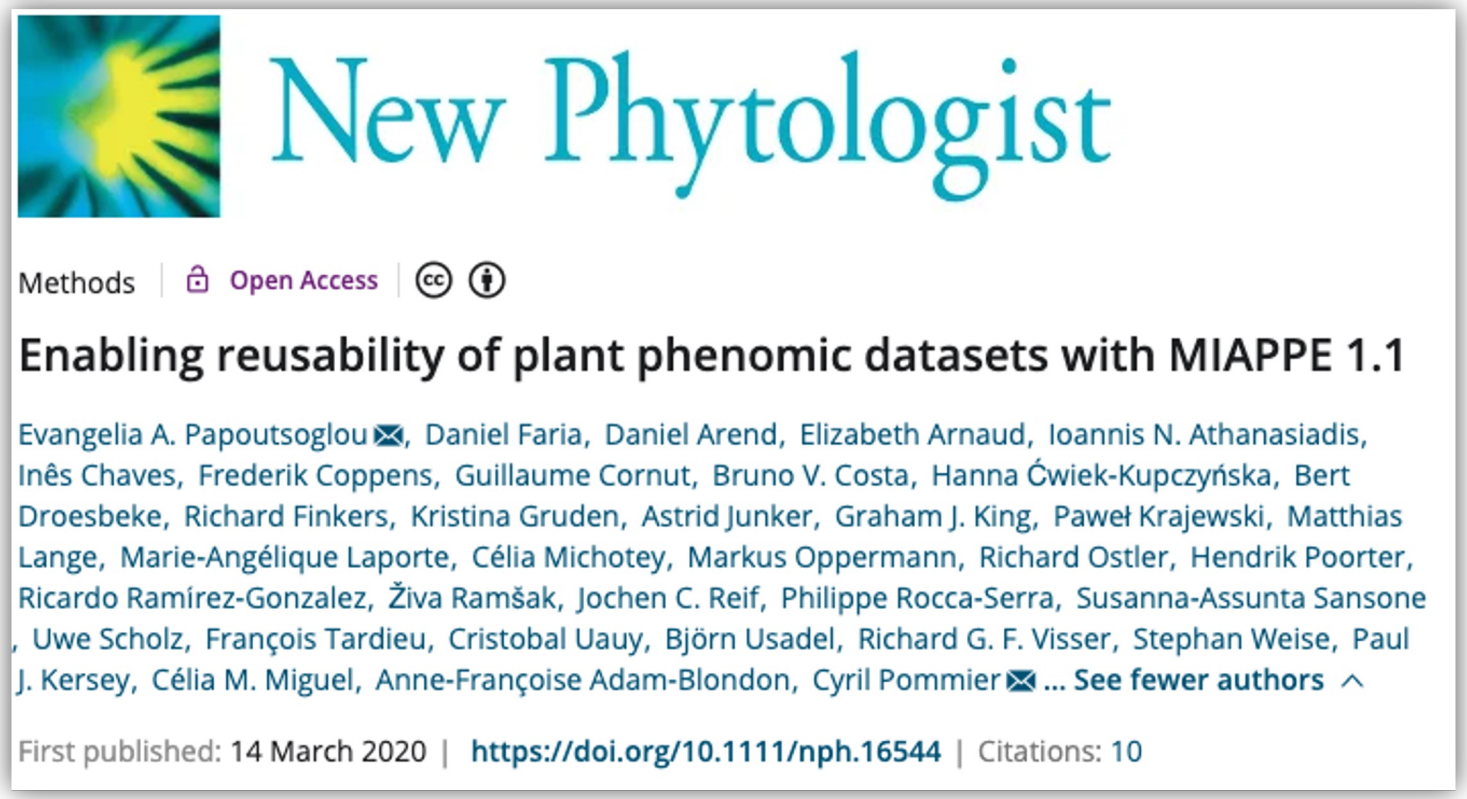
See the support page for full informations

- The latest specifications, data model overview
- The latest specifications field list with description



- Github
  - https://github.com/MIAPPE/MIAPPE/tree/master/MIAPPE_Checklist-Data-Model-v1.1




New Phytologist

Methods | Open Access

Enabling reusability of plant phenomic datasets with MIAPPE 1.1

Evangelia A. Papoutsoglou, Daniel Faria, Daniel Arend, Elizabeth Arnaud, Ioannis N. Athanasiadis, Inês Chaves, Frederik Coppens, Guillaume Cornut, Bruno V. Costa, Hanna Ćwiek-Kupczyńska, Bert Droesbeke, Richard Finkers, Kristina Gruden, Astrid Junker, Graham J. King, Paweł Krajewski, Matthias Lange, Marie-Angélique Laporte, Célia Michotey, Markus Oppermann, Richard Ostler, Hendrik Poorter, Ricardo Ramírez-Gonzalez, Živa Ramšak, Jochen C. Reif, Philippe Rocca-Serra, Susanna-Assunta Sansone, Uwe Scholz, François Tardieu, Cristobal Uauy, Björn Usadel, Richard G. F. Visser, Stephan Weise, Paul J. Kersey, Célia M. Miguel, Anne-Françoise Adam-Blondon, Cyril Pommier ... See fewer authors

First published: 14 March 2020 | https://doi.org/10.1111/nph.16544 | Citations: 10

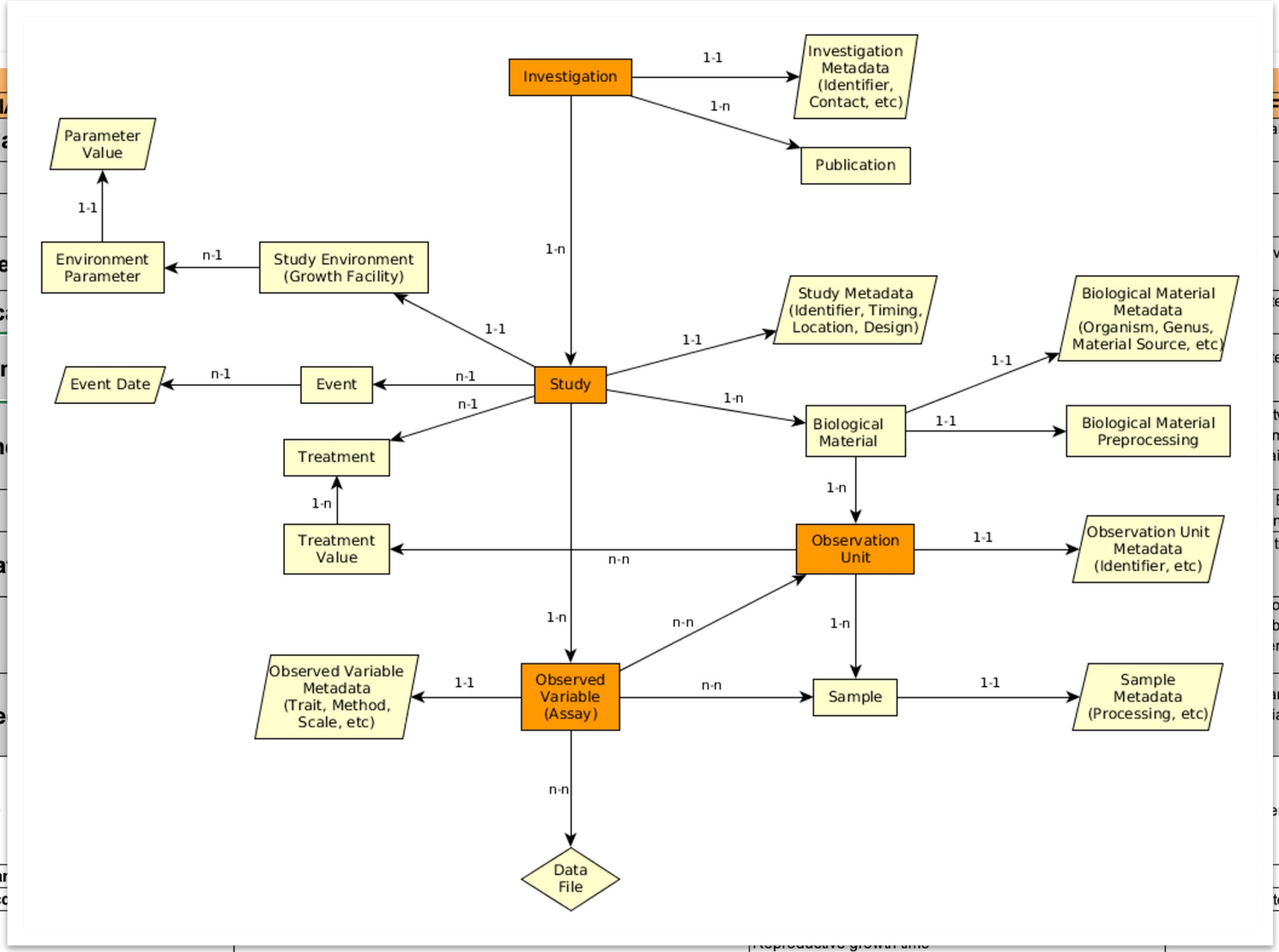
MIAPPE Specifications

- Specification table
- Sections
- Metadata Fields

	MIAPPE				
line #	MIAPPE Check list	Definition	Example	Format	Cardinality
DM-1	**Investigation**	Investigations are research programmes with defined aims. They can exist at various scales (for example, they could encompass a grant-funded programme of work, the various components comprising a peer-reviewed publication, or a single experiment).			1 per MIAPPE submissi
DM-10	**Study**	A study (or experiment) comprises a series of assays (or measurements) of one or more types, undertaken to answer a particular biological question.			1+ per investigation
DM-30	**Person**	A human involved in the investigation or specifically any of its studies.			1+ per investigation / 0+
DM-36	**Data File**	A file or digital object holding observation data recorded during one or more assays of the study, typically in tabular form. Multiple data files may be provided per study, and each file can include observations for several observation units and several observed variables.			0+ per study
DM-40	**Biological Material**	The biological material being studied (e.g. plants grown from a certain bag or seed, or plants grown in a particular field). The original source of that material (e.g., the seeds or the original plant cloned) is called the material source, which, when held by a material repository, should have its stock identified.			1+ per study; 0+ per observation unit
DM-57	**Environment**	Environmental parameters that were kept constant throughout the study and did not change between observation units or assays. Environment characteristics that vary over time, i.e. environmental variables, should be recorded as Observed Variables (see below).			0-1 per study
DM-60	**Experimental Factor**	The object of a study is to ascertain the impact of one or more factors on the biological material. Thus, a factor is, by definition a condition that varies between observation units, which may be biotic (pest, disease interaction) or abiotic (treatment and cultural practice) in nature. Depending on the level of the data, an experimental factor can be either "what is the factor applied to the plant" (i.e. Unwatered), or the "environmental characterisation" (i.e. if no rain on unwatered plant : Drought ; if rain on unwatered plant: Irrigated)			0+ per study; 0+ per observation unit
DM-64	**Event**	An event is discrete occurrence at a particular time in the experiment (which can be natural, such as rain, or unnatural, such as planting, watering, etc). Events may be the realization of Factors or parts of Factors, or may be confounding to Factors. Can be applied at the whole study level or to only a subset of observation units.			0+ per study/observatio
DM-69	**Observation Unit**	Observation units are objects that are subject to instances of observation and measurement. An observation unit comprises one or more plants, and/or their environment. There can be pure environment observation units with no plants. Synonym: Experimental unit.			1+ per study
DM-75	**Sample**	A sample is a portion of plant tissue harvested, non-harvested or extracted from an observation unit for the purpose of sub-plant observations and/or molecular studies. A sample must be used when there is a physical sample that needs to be stored and traced. Otherwise, observations made at the sub-plant level should be recorded as plant level observations using the observed variables to characterize the object of the observation (e.g. Berry sugar content, Fruit weight, Grain Protein content, Leaf 1 width, Leaf 2 width, Leaf 2 length).			0+ per observation unit
DM-82	**Observed Variable**	An observed variable describes how a measurement has been made. It typically takes the form of a measured characteristic of the observation unit (plant or environmental trait), associated to the method and unit of measurement. Multiple variables with the same combination of trait, method and scale can be used in association with different plant parts (leaf 1, leaf 2), when this distinction is necessary for observations referring to different parts of the same observation unit.			1+ per study
DM-83	**Variable ID**	Code used to identify the variable in the data file. We recommend using a variable definition from the Crop Ontology where possible. Otherwise, the Crop Ontology naming convention is recommended: <trait abbreviation>_<method abbreviation>_<scale abbreviation>). A variable ID must be unique within a given investigation.	Ant_Cmp_Cday	Unique identifier	1
DM-84	**Variable name**	Name of the variable.	Anthesis computed in growing degree days	Free text	0-1
DM-85	**Variable accession number**	Accession number of the variable in the Crop Ontology	CO_322:0000794	Crop Ontology term	0-1
DM-86	**Trait**	Name of the (plant or environmental) trait under observation	Anthesis time Reproductive growth time	Free text	1
DM-87	**Trait accession number**	Accession number of the trait in a suitable controlled vocabulary (Crop Ontology, Trait Ontology).	CO_322:0000030 TO:0000366	Term from Plant Trait Ontology, Crop Ontology, or XML Environment Ontology	0-1

MIAPPE Specifications

- Specification table
- Sections
- Metadata Fields
- Linked and organized

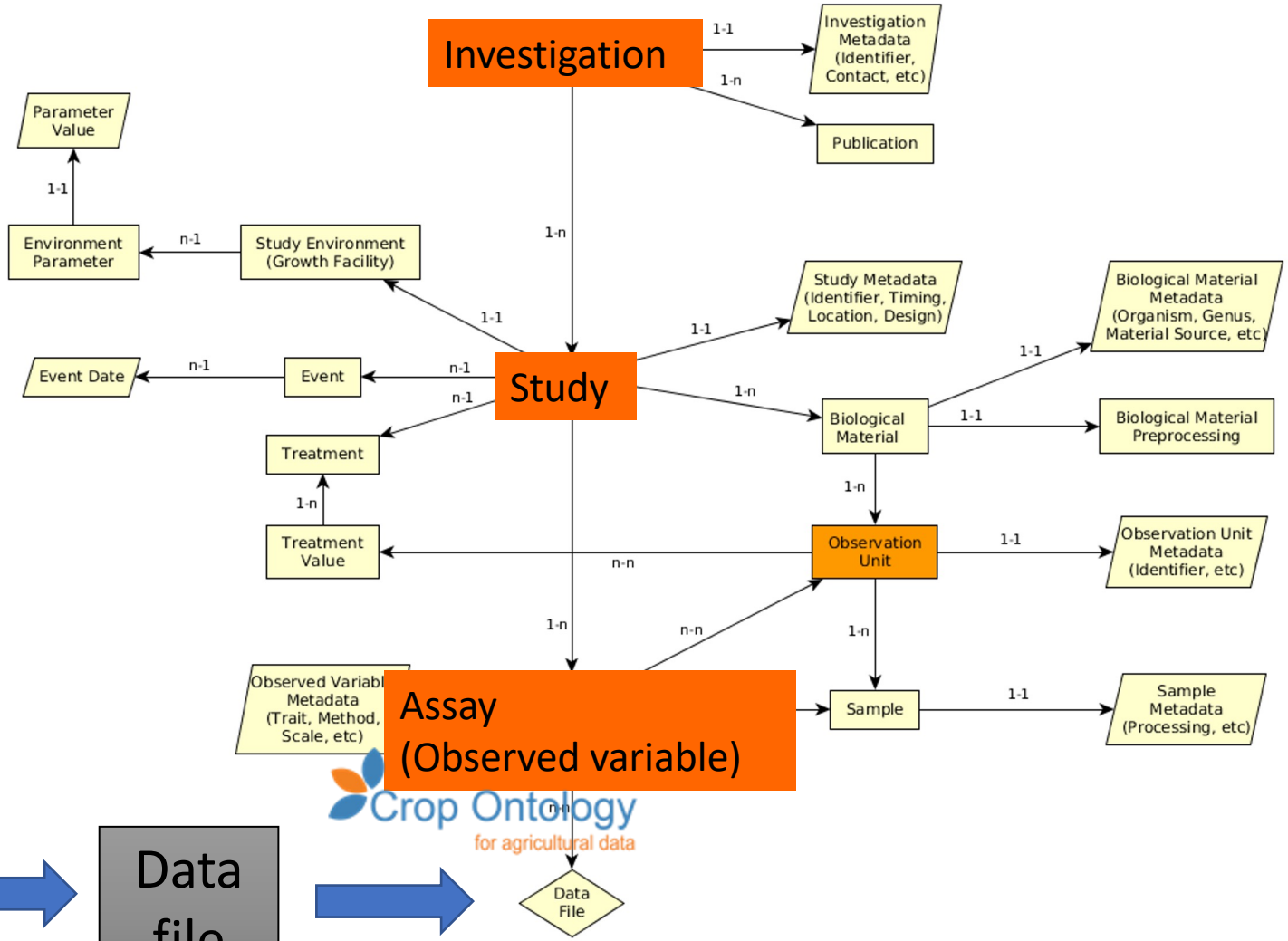


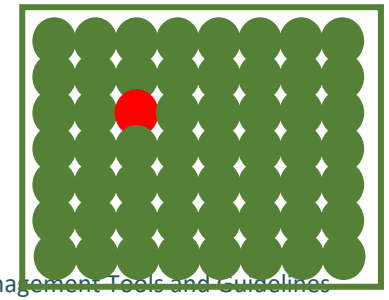
line #	MI			Format	
DM-1	Investiga			amme of work, the	1 per
DM-10	Study				1+ pe
DM-30	Person				1+ pe
DM-36	Data File			vided per study, and	0+ pe
DM-40	Biologic			erial (e.g., the seeds or	1+ pe 0+ pe
DM-57	Environ			eristics that vary over	0-1 p
DM-60	Experim			tween observation mental factor can be in on unwatered plant:	0+ pe 0+ pe
DM-64	Event			Events may be the nits.	0+ pe
DM-69	Observa			their environment.	1+ pe
DM-75	Sample			olecular studies. A be recorded as plant nt, Leaf 1 width, Leaf 2	0+ pe
DM-82	Observe			nt or environmental iation with different	1+ pe
DM-83	Variable ID			er	1
DM-84	Variable nar				0-1
DM-85	Variable acc			term	0-1
DM-86	Trait				1
DM-87	Trait accession number	Accession number of the trait in a suitable controlled vocabulary (Crop Ontology, Trait Ontology).	CO_322:0000030 TO:0000366	Term from Plant Trait Ontology, Crop Ontology, or XML Environment Ontology	0-1

MIAPPE V1.1 Overview the (ISA) backbone

- **Investigation**: whole dataset
- **Study** : one experiment in one location for one to several year
- **Assay**:
  - trait or indice (Pheno or Env) observed
  - Level + Trait + Method + Scale/Unit

- Level:
  - Plant
  - Microplot
  - Block
  - Trial
  - …

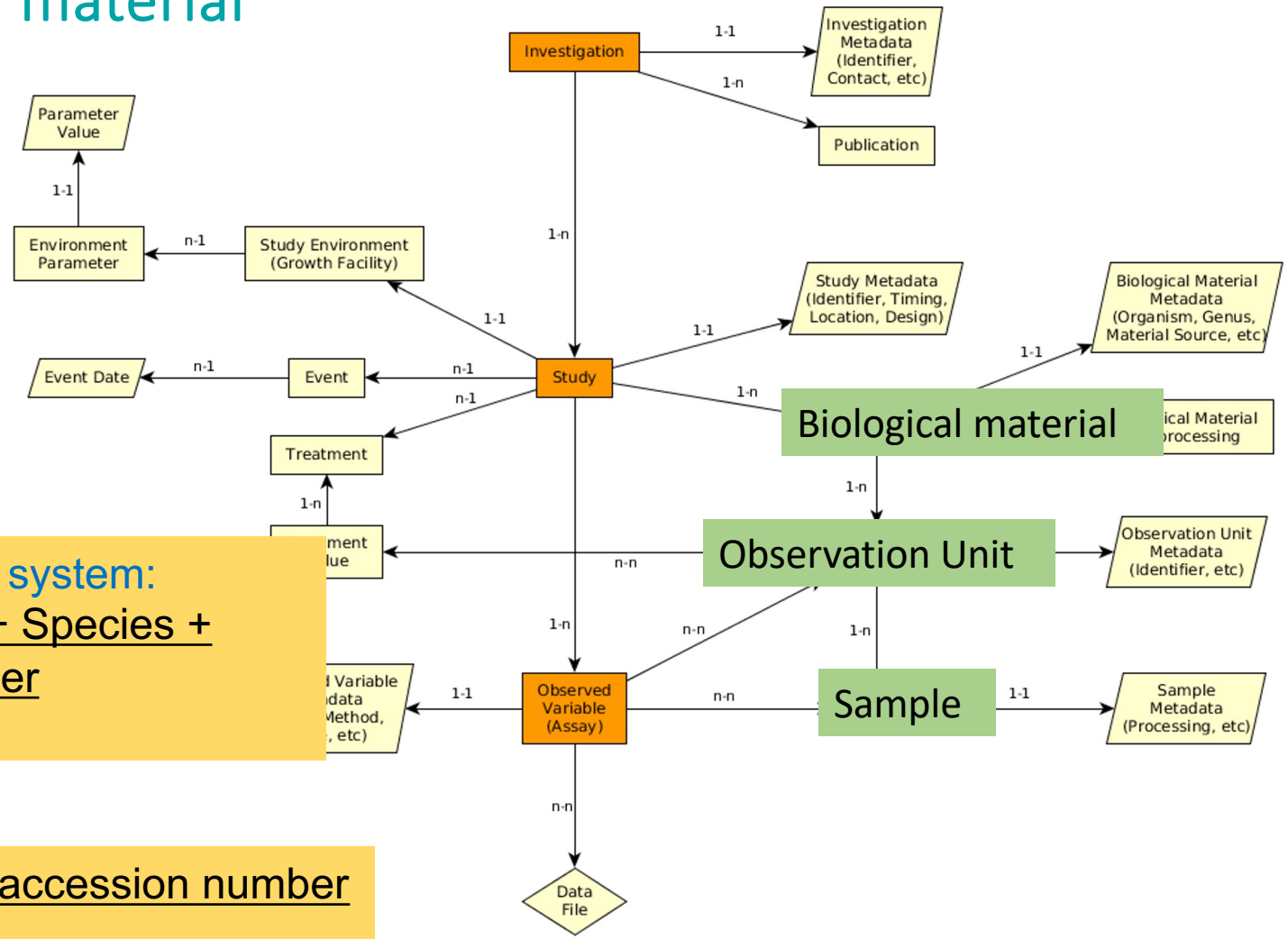




Data file

MIAPPE main sections – Biological material

- Plant Material
  - **Identification**
  - **Description**
- Multi Crop Passport Descriptor



Material Source: accession, cultivar/variety, region of provenance, laboratory cross, ...

MCPD identification system:
- Genebank/Lab + Species + accession number
- DOI

Biological material used in the study: seed lot, cuttings…

- Lab + internal accession number
- URI

Plant Samples used in the study: detached leaves, ...

- Lab + internal accession number (mandatory)
- BioSample ID

• MIAPPE main sections – Observed Variable (Assay)

- Plant Phenomic Specific Ontology Model:

Phenotyping/environment variable = ***Trait + Method + Unit/Scale***

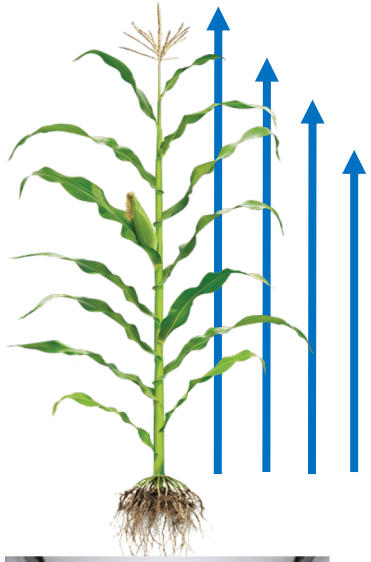
Trait + Method + Unit

Crop Ontology for agricultural data

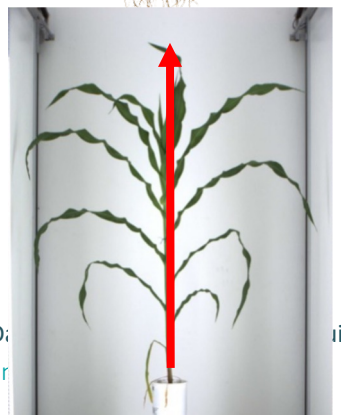
EMPHASIS elixir

Slide:
L Cabrera-Bosquet

miappe



T1: Plant Height



M1: Total height

M2: First tassel branch

M3: Last expanded leaf

M4: Youngest growing leaf

M5: Highest pixel corresponding to plant

U1: cm
U2: mm

U3: pixel

AgroPortal LIRMM

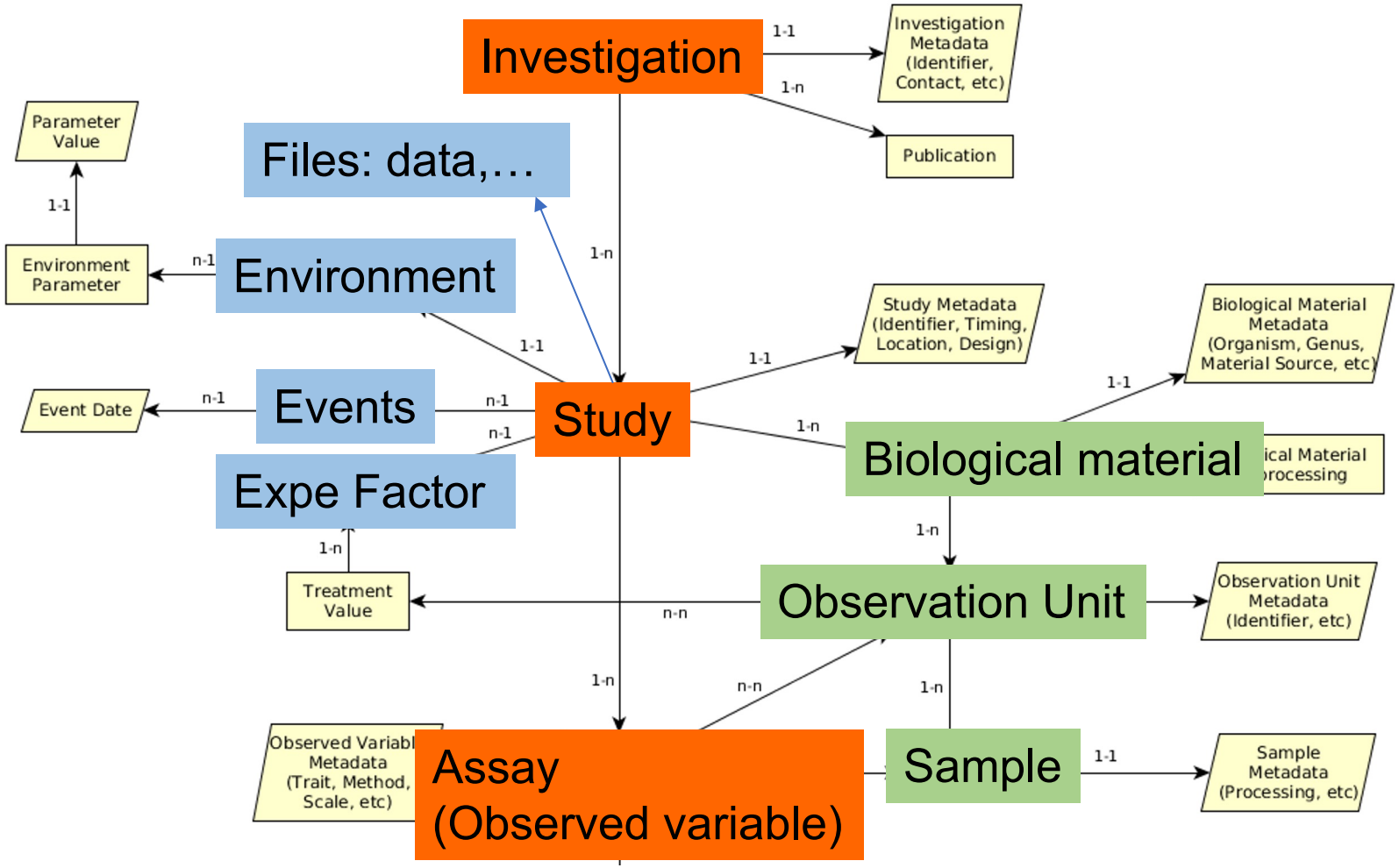
Ontology Lookup Service
Home | Ontologies | Documentation | About

PLANT BIOINFORMATICS FACILITY

PHENOME French Plant Phenomic Infrastructure EMPHASIS

INRAE EMPHASIS

• MIAPPE – Other Important sections



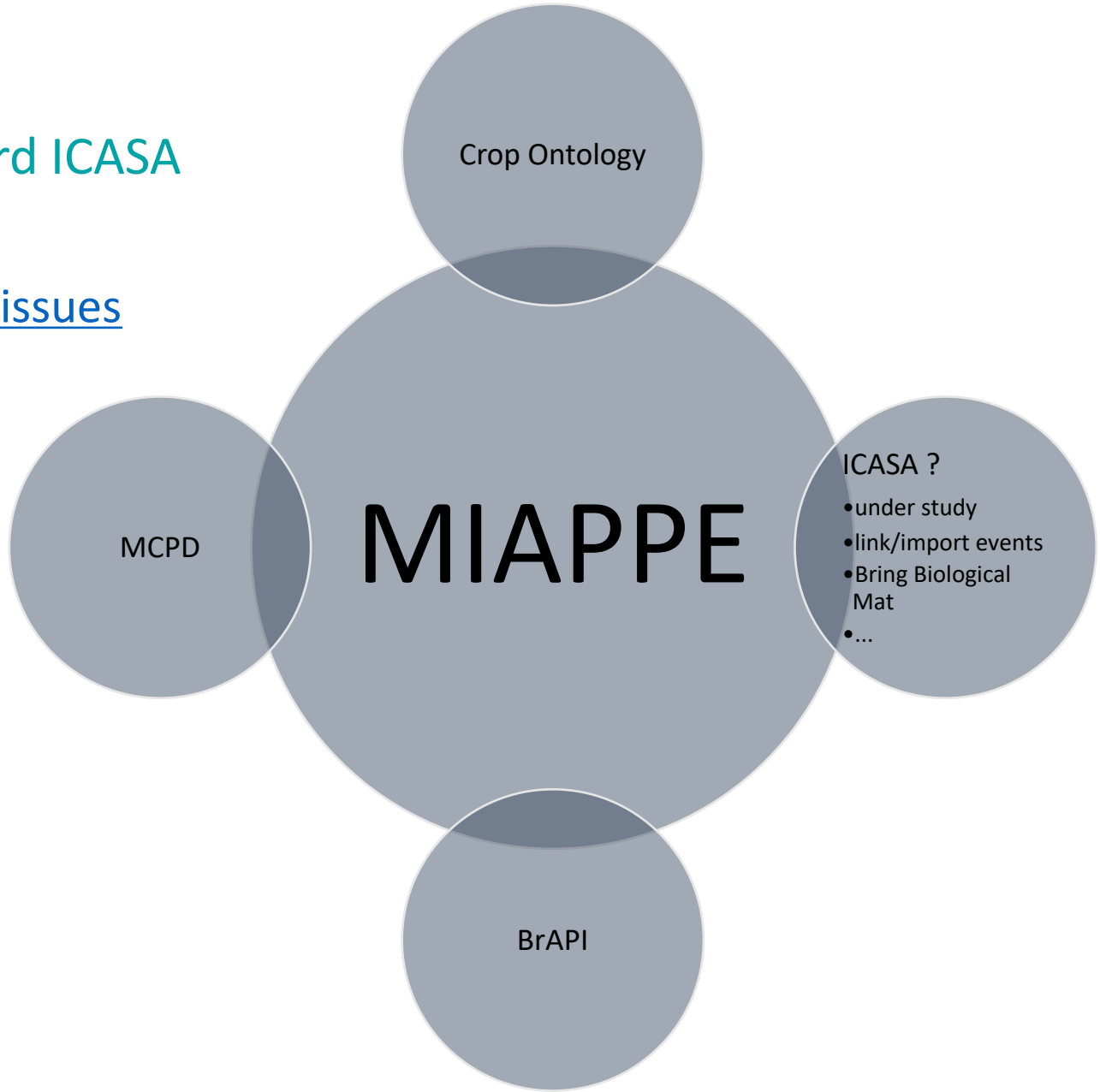
- MIAPPE Overview
  Data file content

- Any format (Near Infra Red Spectrum, Images, Image Archives references, ….)
- Mostly tabular

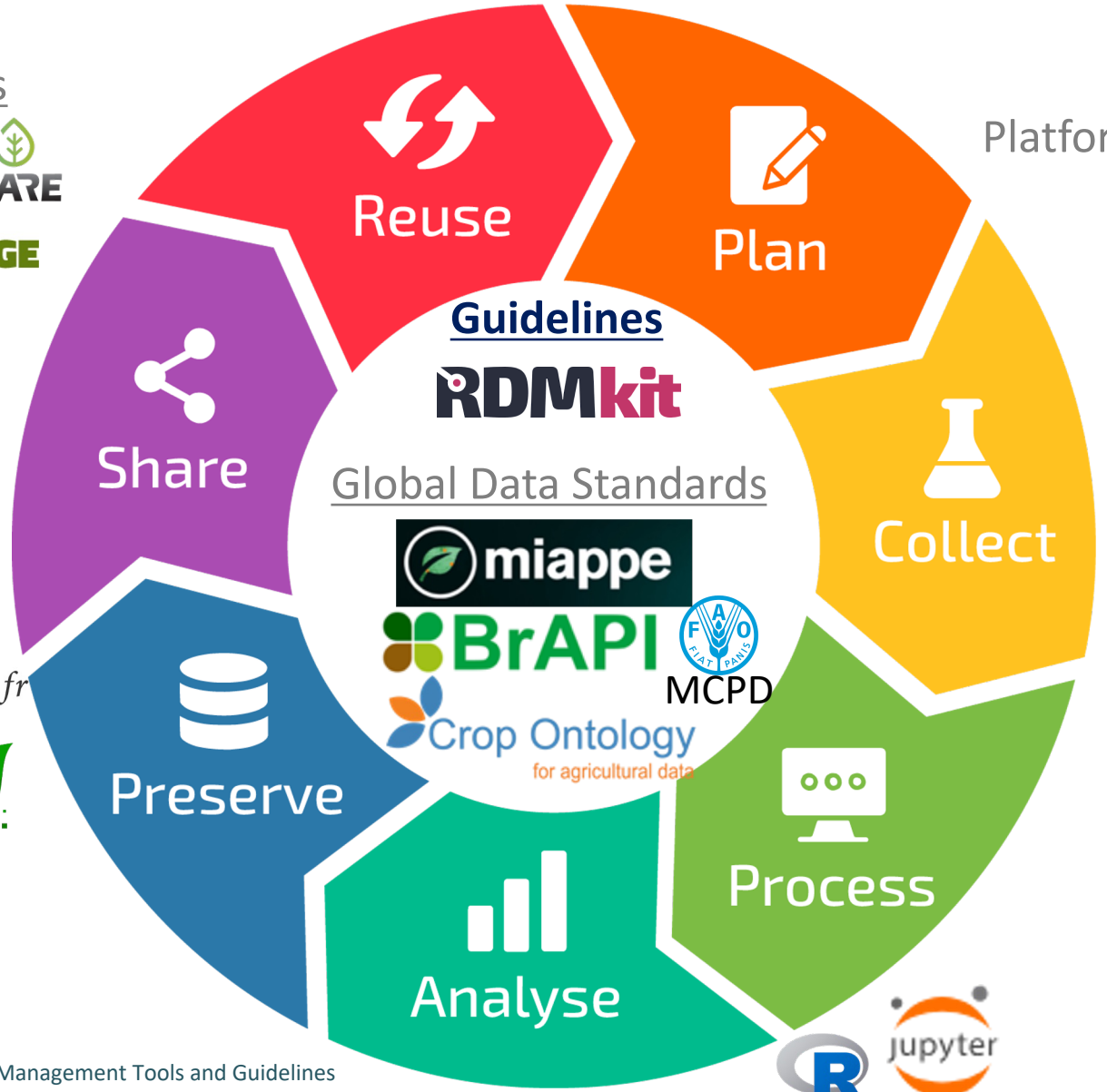
A	B	C	D	E	F	G	H	I
Accession Number	Trial Site	Campaign	Circum1: Tree circumference at 1 year	Date [Circum1]	Height1: Tree total height at 1 year	Date [Height1]	Shoots3: Number of resprouts at 3 years	Date [Shoots3]
661300270	Ardon	2004	45.645632645603683	12/01/2004	284.3	12/01/2004		
661300270	Ardon	2005					14.630625	12/05/2005
661300444	Ardon	2004	38.96112577281653	12/01/2004	228.8	12/01/2004		
661300444	Ardon	2005					8.5030559999999991	12/05/2005
661300312	Cavallermaggiore	2004	52.4	01/01/2004	249.9	01/01/2004		
661300312	Cavallermaggiore	2005					12.981609000000001	01/05/2005
661300371	Cavallermaggiore	2004	45.74	01/01/2004	230.2	01/01/2004		
661300371	Cavallermaggiore	2005					10.3041	01/05/2005
661300487	Cavallermaggiore	2004	72.52	01/01/2004	309.8	01/01/2004		
661300487	Cavallermaggiore	2005					10.679823999999998	01/05/2005
661300585	Cavallermaggiore	2004	71.739999999999995	01/01/2004	305.7	01/01/2004		
661300585	Cavallermaggiore	2005					10.956100000000001	01/05/2005
661300468	Headley	2004	45.27	01/01/2004	247	01/01/2004		
661300468	Headley	2005					15.888196000000002	01/05/2005
661300469	Headley	2004	70.930000000000007	01/01/2004	313	01/01/2004		
661300469	Headley	2005					13.271448999999999	01/05/2005
661300533	Headley	2004	57.67	01/01/2004	258.8	01/01/2004		

MIAPE perspectives

- Recommended data file format
- Extend standard interoperability toward ICASA
- Github issues
  - https://github.com/MIAPPE/MIAPPE/issues



Overview



Data portals

FAIDARE

FLORILÈGE

Data repositories

The Dataverse Project

recherche.data.gouv.fr

zenodo

EMBL-EBI

PHIS

Platform Information Systems

GRIN-Global

Outil Local de Gestion des Accessions

PHIS

PIPPA

Portable devices, sensors, …

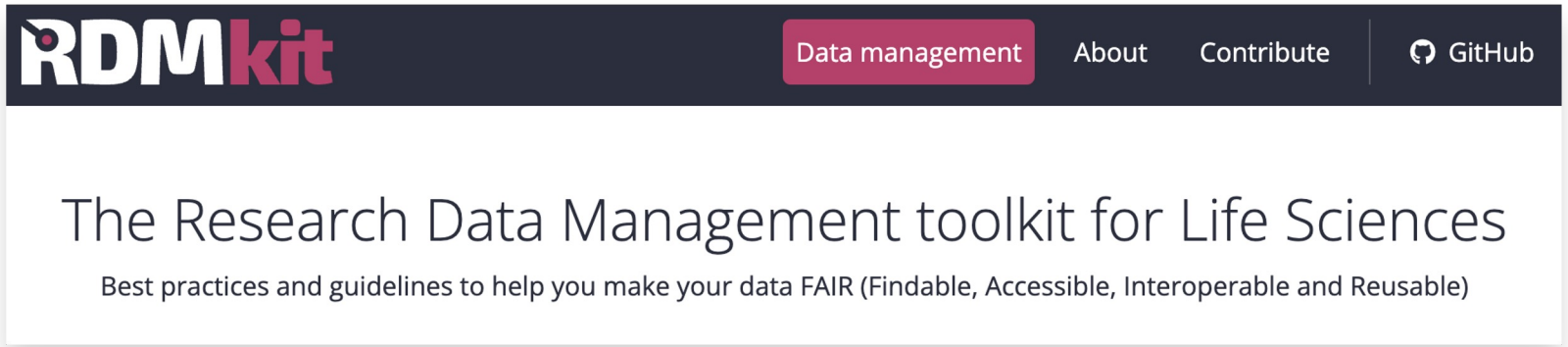
Scripts and Workflows

R

jupyter

Community guidelines portal : RDMkit - Best practices and guidelines for FAIR data management

- A "wikipedia-like" knowledge base website, free and open
- Describes how to manage research outputs according to FAIR principles
- Portal to other online resources used by RDM professionals and researchers



URL: https://rdmkit.elixir-europe.org/

Recommended in the **Horizon Europe Program Guide** as the "resource for Data Management guidelines and good practices for the Life Sciences"

RDMkit in numbers

179

Contributors
The force behind RDMkit

514

Tools & resources
Explained in the context of real world problems

122

Pages
Helping you with data management

- Contributors are experts in RDM and/or in scientific domain in ELIXIR and beyond
- Managed by an editorial board
  - **ELIXIR members from several Nodes**
  - **lead for "FAIR Data & Resources" at the Office of Data Science Strategy at NIH**
- The content is curated by members of the ELIXIR RDM Community

Your domain

Considerations

- Did you collect the metadata for the identification of your plant material according to the recommendation provided in the above section?
- Have you documented your phenotyping and environment assays (i.e. measurement or computation methodology based on the trait, method, scale triplet) both for direct measures (data collection) and computed data (after data processing or analysis)?
  - Is there an existing Crop Ontology for the species you experiment and does it describe your assay? If not, have you described your data following the trait, method, scale triplet?
- Do you have your own system to collect data and is it compliant with the MIAPPE standard?
- Are you exchanging data with individual researchers?
  - In what media is data being collected?
  - Is the data described in a MIAPPE-compliant manner?
- Are you exchanging data across different data management platforms?
  - Do these platforms implement the Breeding API BrAPI specification?
  - If not, are they MIAPPE-compliant and do they enable automated data exchange?

On this page

Introduction
Data management planning
Plant biological materials: (meta)data collection and sharing
Phenotyping: (meta)data collection and publication
Genotyping: (meta)data collection and publication
Related pages
More information
Relevant tools and resources

Solutions

Checklists and ontologies

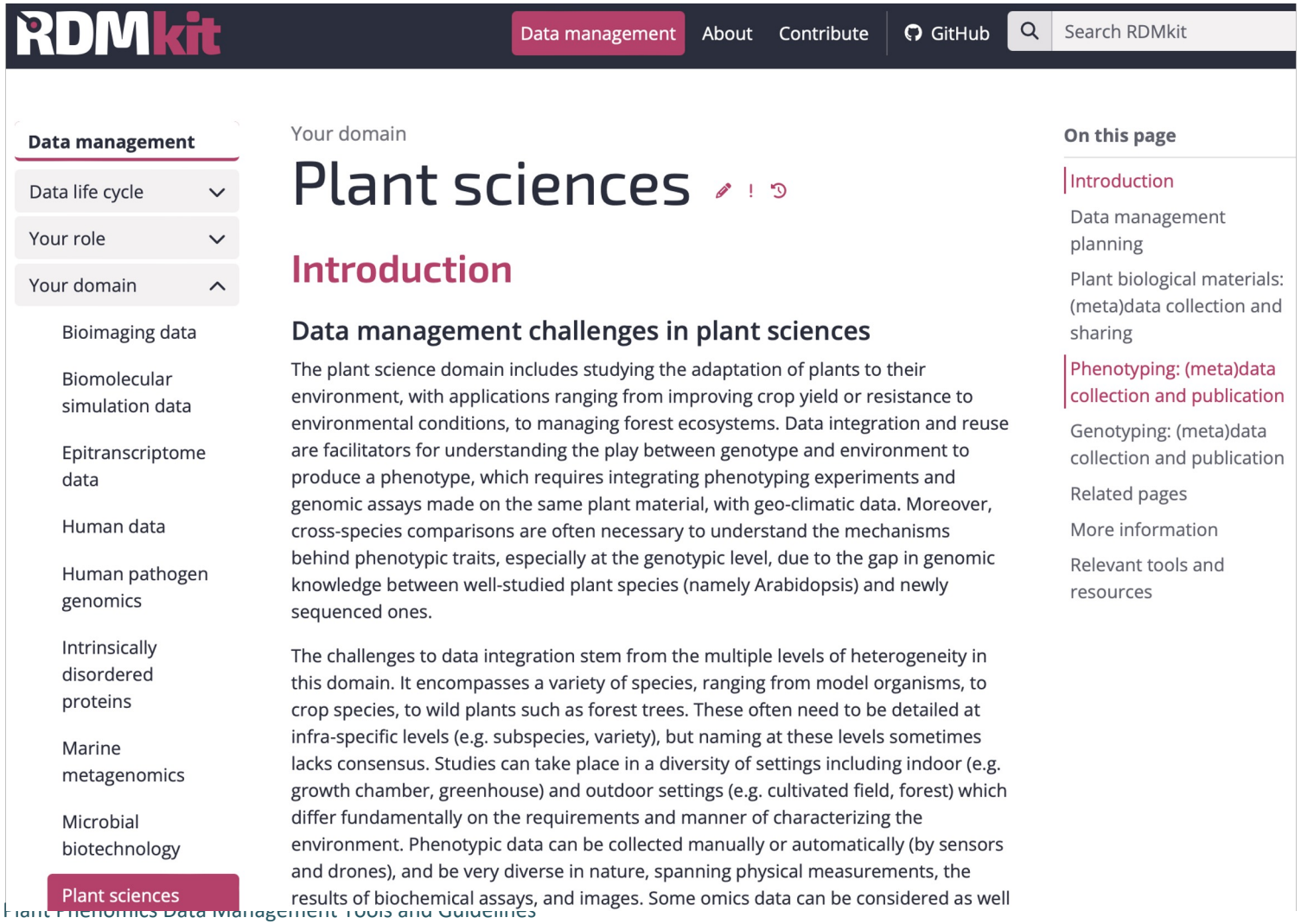
- The metadata standard applicable to plant phenotyping experiments is MIAPPE.
  - There is a section dedicated to the identification of plant biological materials that follows Multi-Crop Passport Descriptor (MCPD) described above.
  - There is a section to describe the phenotyping assays based on the Crop Ontology recommendations.

Data management practices in a domain

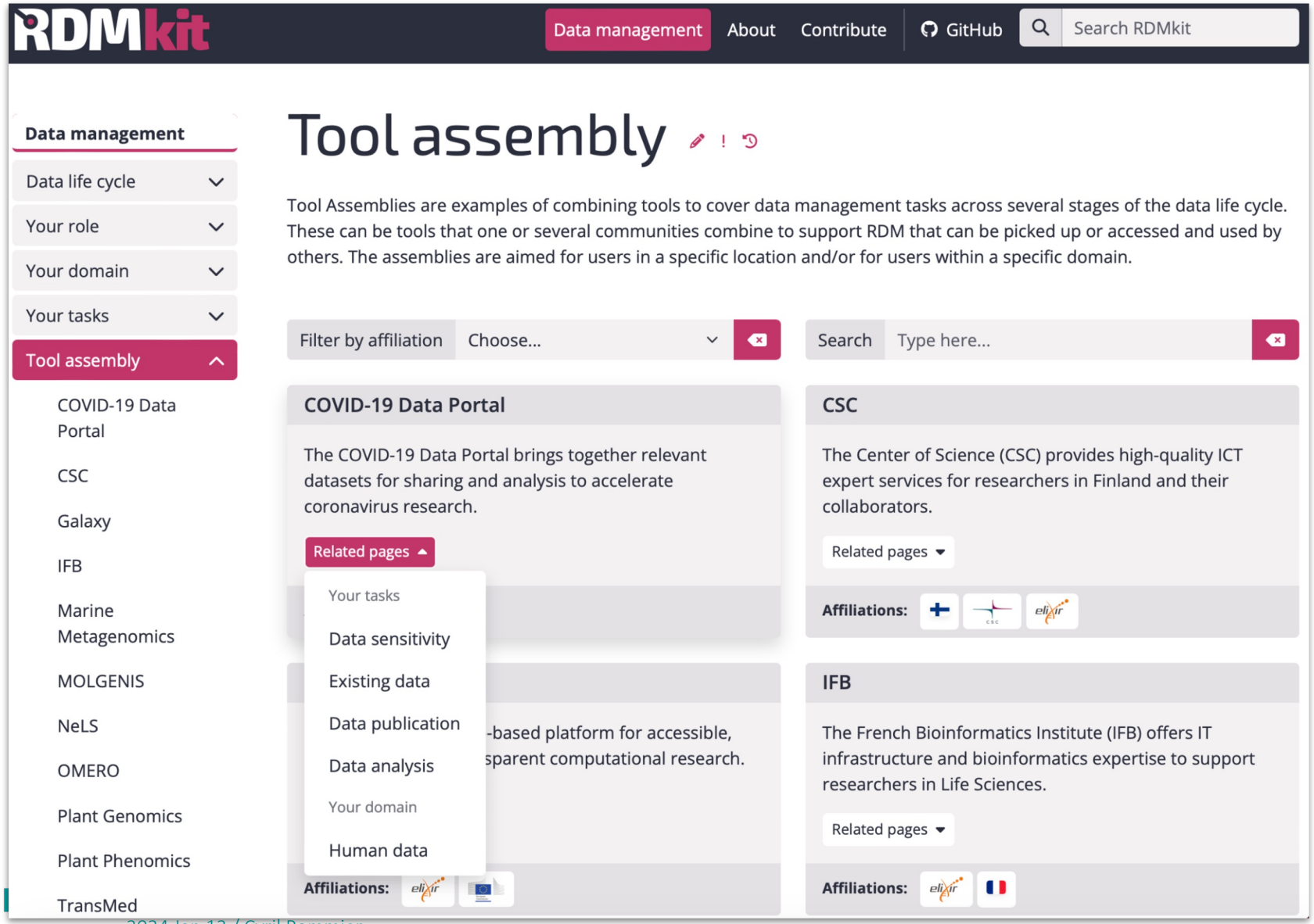
- what aspects should be taken into account (considerations)
- available solutions
- links to tools and resources explained in clear context (when to use them and for what purpose)

Plant Pages

https://rdmkit.elixir-europe.org/plant_sciences



Tool assembly



Tool assemblies for plant data

Plant phenomics

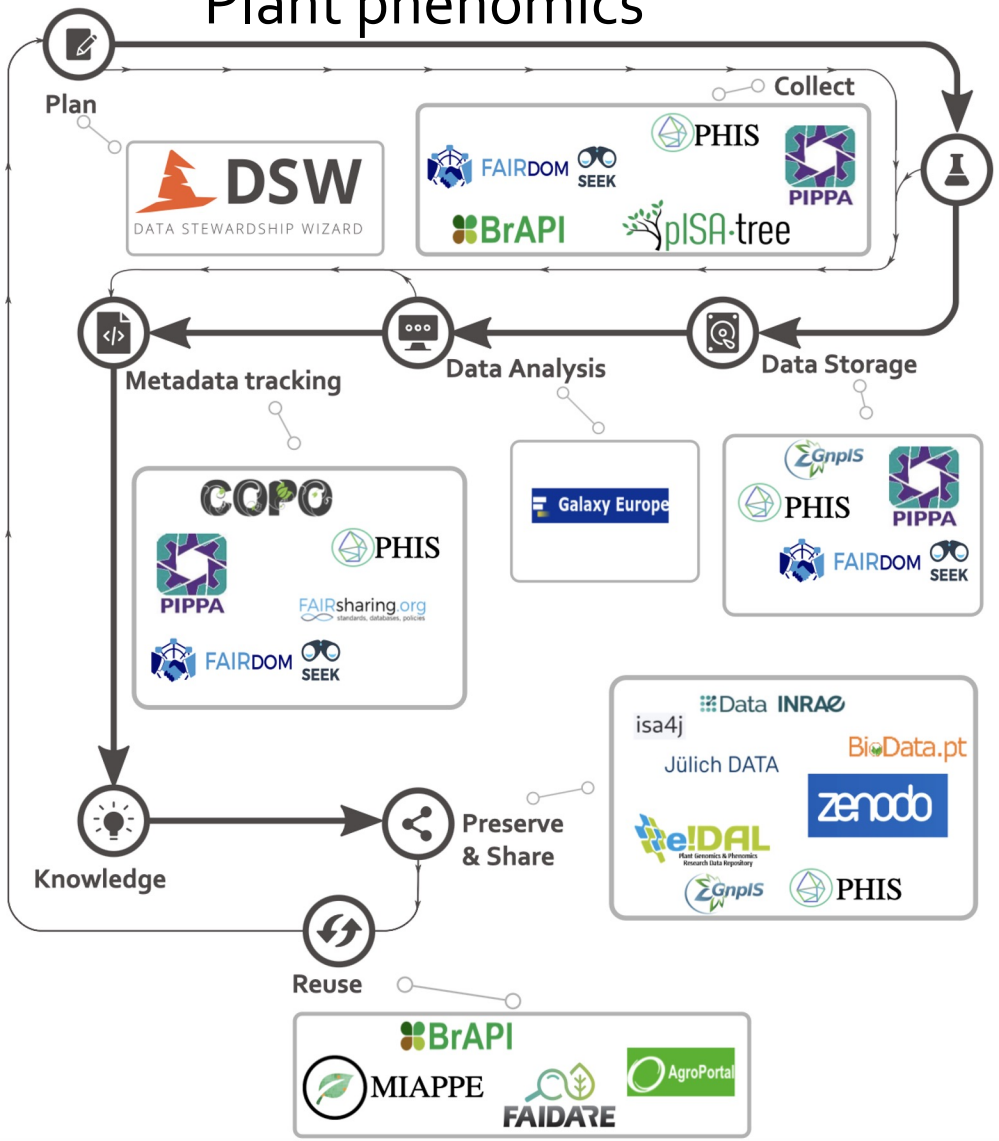


Figure 1. The plant phenomics tool assembly.

Plant genomics

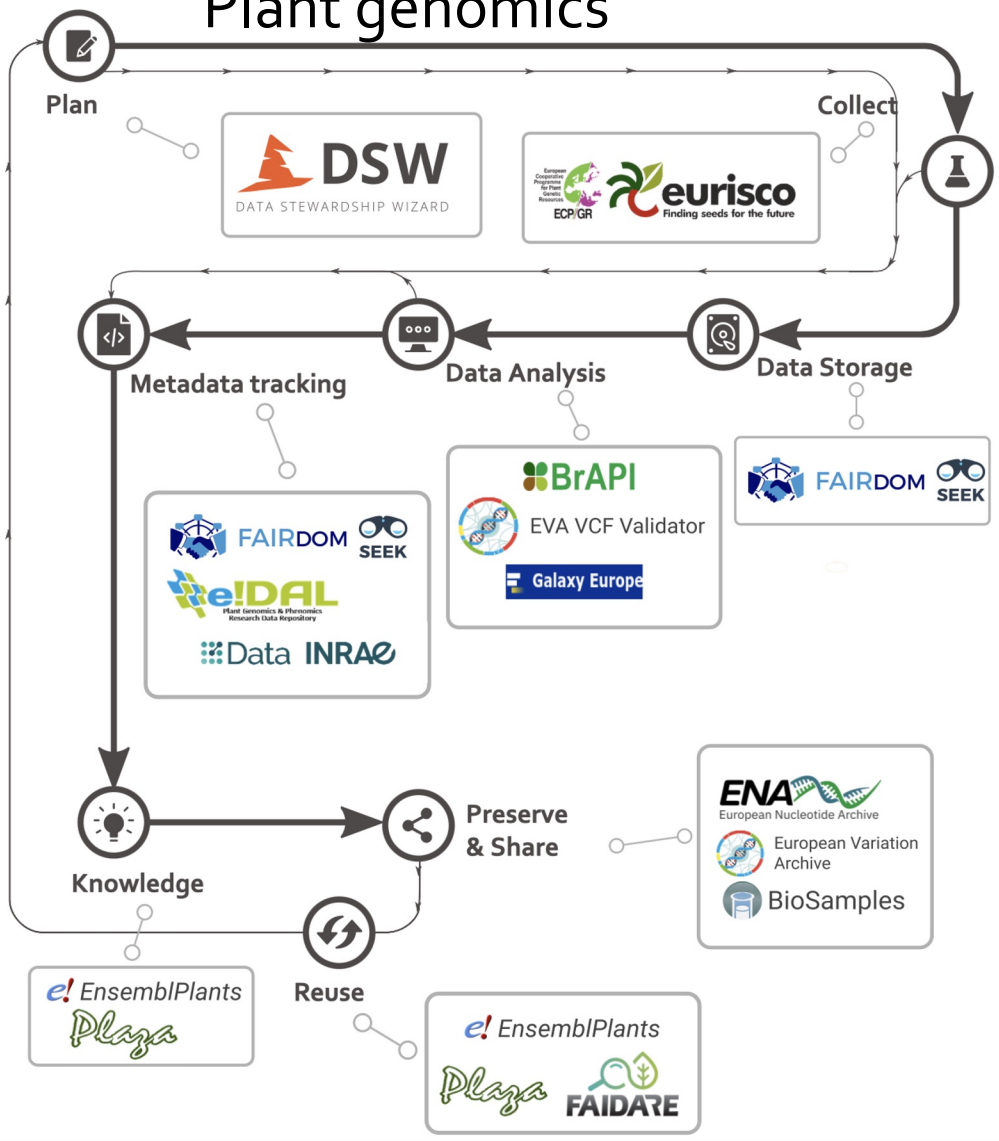


Figure 1. The plant genomics tool assembly.

Tool assemblies for plant data

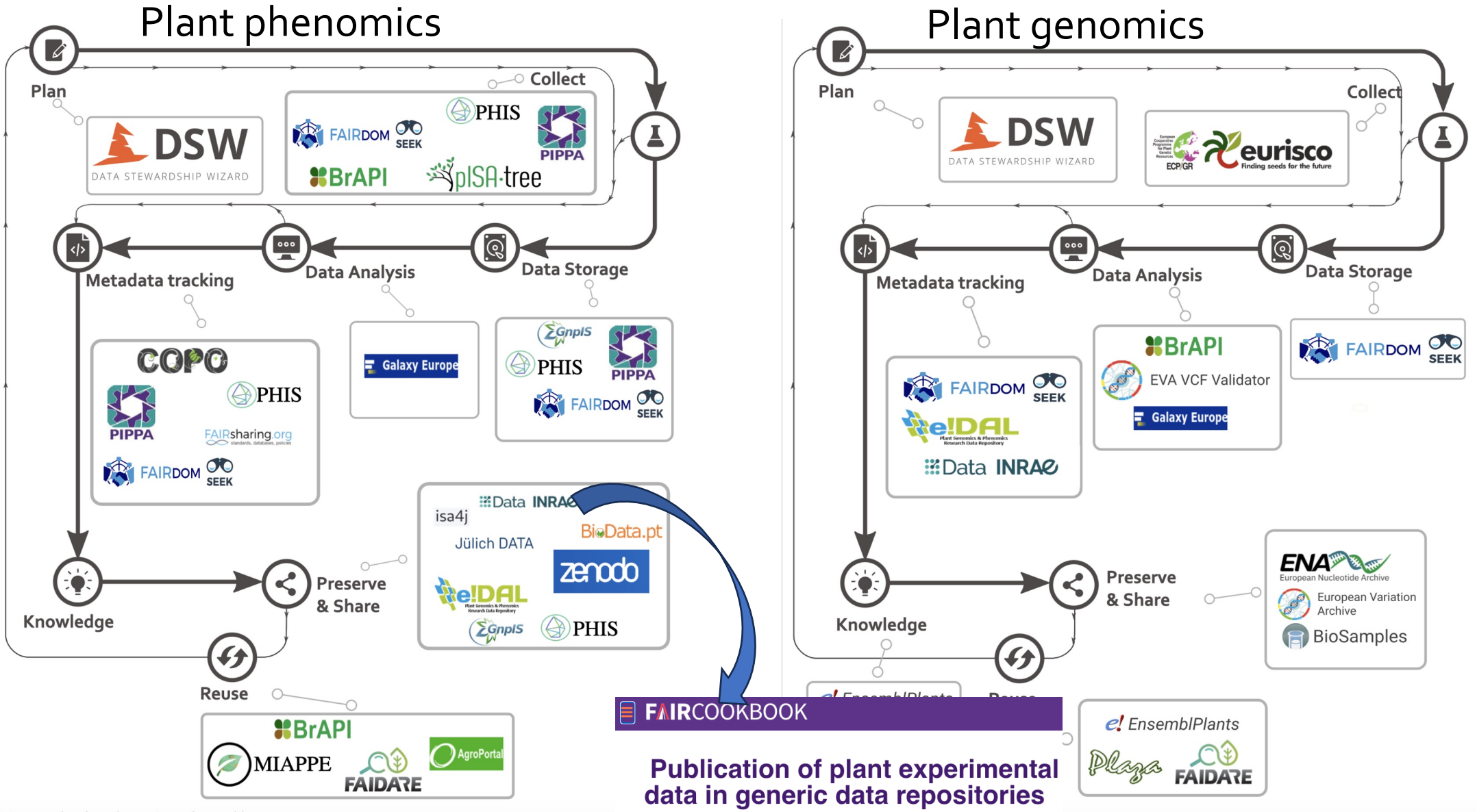


Figure 1. The plant phenomics tool assembly.

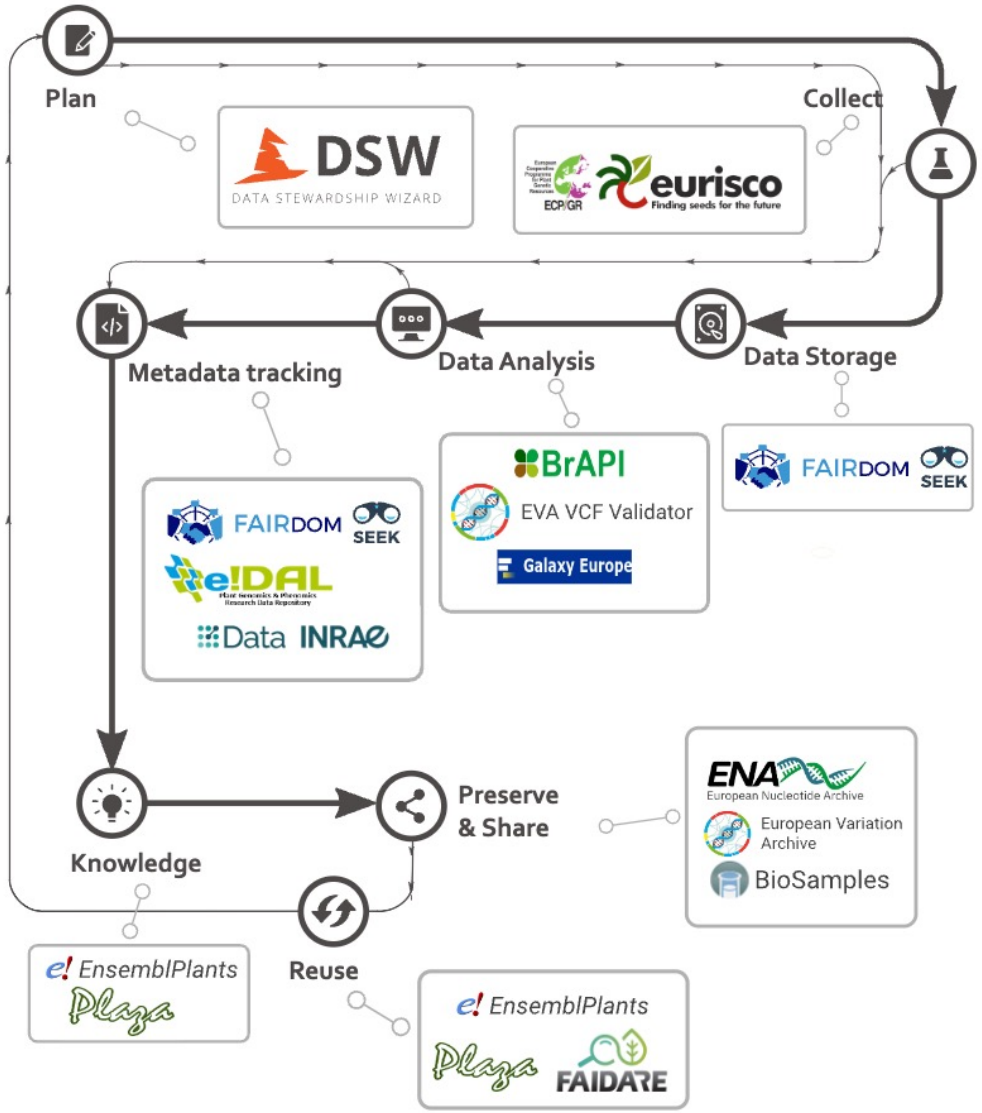
Figure 1. The plant genomics tool assembly.

Plant Genomic assembly

Publish Sequence and Variation @ EMBL-EBI

- Step by step procedure
- Publish data @ EBI
- Ensure interoperability from Pheno to Geno

https://rdmkit.elixir-europe.org/plant_genomics_assembly



Plant Phenomic assembly

Publish in generic data repositories

- Dataverse
  - Zenodo
  - e!Dale
- PAG Computer Demo
  - Saturday the 13th at 13:30 Town and Country D

Details

Location: Town and Country D
Date: Saturday, Jan 13 1:30 PM
Duration: 2 hours 10 minutes

Presentation

1:30 PM Long Term Plant Phenomic Data Sharing in Generic Data Repositories (Zenodo, Dataverse) Using MIAPPE

https://rdmkit.elixir-europe.org/plant_phenomics_assembly

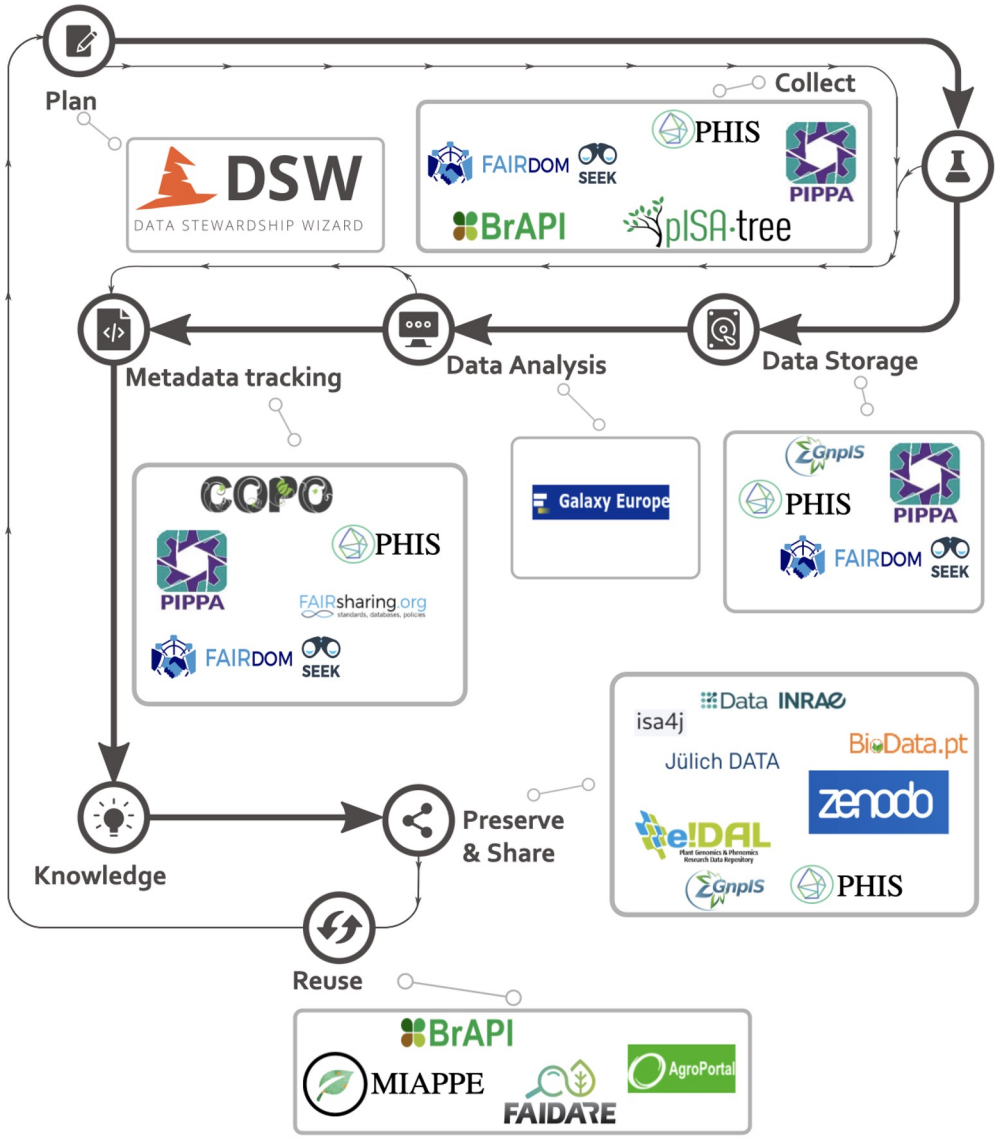


Figure 1. The plant phenomics tool assembly.

Dataverse

https://faircookbook.elixir-europe.org/content/recipes/reusability/plant-pheno-data-publication.html#step-by-step-process-for-data-submission-and-publication-in-dataverses

https://demo.dataverse.org/

Step 1: Dataset creation: Minimal metadata

Step 1: Dataset creation

Find an appropriate dataverse

You need first to select the appropriate dataverse and/or sub-dataverse for your use case depending on the constraints of your consortium or institute. The guidelines explained below are applicable to all of those dataverse instance. You will find below a non -exhaustive list of dataverse instances. Also, find the right sub-dataverse for your submission, like the one of the research group or the project you belong to: dataverses can contain dataverses.

- recherche.data.gouv.fr (FR)
  - Open to submission from any consortium involving at least one member of
  - Examples: Data INRAE and CIRAD.
- Jülich DATA (NRW - DE)
  - Open to submission from any research activity done from partners at Forsch
  - Meant for data and software submissions.
  - Maintained by the central library of FZJ.
  - Examples under subject "Agricultural Sciences".
- dmportal.biodata.pt (PT)
  - Open to submission of biological data from Portuguese research & innovatic
  - Example: Plant BioDataVerse.

Data repositories minimal description limitations

- (Too) broad metadata
  - **Year, Data type, Author**
  - **Organism: no controlled vocabulary**
  - **Keyword, Subject**
- Lacking plant phenomic specific metadata
  - **Biological material, from species to genetic resource accession**
  - **Traits**
  - **Experiment locations**
  - **…**
- Need of dedicated metadata scheme, added to generic data repositories
  - **As additional metadata → Filling long list in the repository form is not an option**
  - **As companion files**

➔ MIAPPE data standard

MIAPPE @ Dataverse

Step 2: Add mandatory metadata for plant phenotyping data

Biological material

Use BiologicalMaterial.xlsx. This spreadsheet contains the following fields: Mandatory fields:

- “Biological material ID” (ex: INRA:W95115_inra_2001): Lot number or material identifier in the data files
- “Material source ID” (ex: INRA:B73_usda) OR “Accession_number” (B73_usda) + “Holding_institute” (ex: INRA)
- Accession Number
- Genus
- Species Optional fields:
- “Material source DOI”: accession DOI
- Organism: NCBITAXON:4577
- “Infraspecific name”: variety names, cultivar names, etc…
- Genealogy:
  - Parent1or2_AccessionNumber
  - Parent1or2_TaxonGroup
  - Parent1or2_HoldingInstitutionName
  - Parent1or2_Type (father/mother/undefined)
- All MIAPPE Biological Material fields (DM-40 to DM-56)
- Free input: synonyms, project IDs, any relevant information on the plant material.

Observed variables

Use ObservedVariables.xlsx. This file is needed for the description of phenotyping experiments traits and methods.

Studies or experiments

It is recommended to list the experimentation done in this dataset, including in particular the GPS location, the site name and the environmental parameters which characterize the experimental sites. Use Studies.xlsx

How to add metadata files in a Dataverse

- Click on “+ Upload Files” in the “Files” tab
- Add the file(s). Please note that :
  - the file size is limited to 15.0 GB
  - compressed files are automatically decompressed at the time of import
  - tabbed files must use the “,” separator and “UTF-8” encoding to avoid problems during import (see the dedicated section in the user guide)
- Fill in the “Description” field for each added file
- Update the file labels by selecting “File options” > “Tags” for each file

Update the file labels

- Add a custom label, “Biological_Material” or “Observed_Variable” depending on the file type. If the label exists, it will be available in the “File labels” section, otherwise you will have to create it in the “Customize file label” section and apply it.

Add a custom label

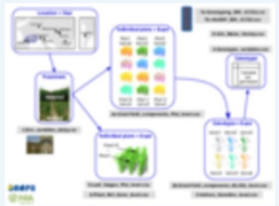
- Save your modifications

Maize Example

DROPS project dataset: https://doi.org/10.15454/IASSTN

A multi-site experiment in a network of European fields for assessing the maize yield response to environmental scenarios

Version 4.0



Millet, Emilie J.; Pommier, Cyril; Buy, Mélanie; Nagel, Axel; Kruijer, Willem; Welz-Bolduan, Therese; Lopez, Jeremy; Richard, Cécile; Racz, Ferenc; Tanzi, Franco; Spitkot, Tamas; Canè, Maria-Angela; Negro, Sandra S.; Coupel-Ledru, Aude; Nicolas, Stéphane D.; Palaffre, Carine; Bauland, Cyril; Praud, Sébastien; Ranc, Nicolas; Presterl, Thomas; Bedo, Zoltan; Tuberosa, Roberto; Usadel, Björn; Charcosset, Alain; van Eeuwijk, Fred A.; Draye, Xavier; Tardieu, François; Welcker, Claude, 2019, "A multi-site experiment in a network of European fields for assessing the maize yield response to environmental scenarios", https://doi.org/10.15454/IASSTN, Recherche Data Gouv, V4, UNF:6:zS2/ccOQxFrKlUt+1S0Cvg== [fileUNF]

Cite Dataset · Learn about Data Citation Standards.

Access Dataset · Contact Owner · Share

Dataset Metrics
15,218 Views
7,235 Downloads
3 Citations

Description

This dataset comes from the European Union project DROPS (DROught-tolerant yielding PlantS). A panel of 256 maize hybrids was grown with two water regimes (irrigated or rainfed), in seven fields in 2012 and 2013, respectively, spread along a climatic transect from western to eastern Europe, plus

MIAPPE Metadata

10-Info-ObservedVariable.tab
Tabular Data - 21.8 KB
Published Nov 3, 2022
196 Downloads
17 Variables, 91 Observations UNF:6:bxOj...iaQ==
List of phenotypic and environmental variables used in the dataset, following the MIAPPE data standard (https://www.miappe.org/)
Observed Variable

11-Info-Study.tab
Tabular Data - 6.4 KB
Published Nov 3, 2022
180 Downloads
11 Variables, 19 Observations UNF:6:9nO7...GEQ==
List of studies, including locations, used in the dataset, following the MIAPPE data standard (https://www.miappe.org/)
Study

VariableID	VariableName	VariableAccessionNumber
Tnight	Night temperature	EIPO:0000001
Ri	Solar radiation	EIPO:0000002

StudyTitle	StudyUniqueID	ExperimentalSiteName	GeographicLocationLatitude	GeographicLoca
Biogemma Gaillac 2012	Gai12	Gaillac	43.9	1.89
Biogemma Gaillac 2013	Gai13	Gaillac	43.9	1.89

MIAPPE Metadata

8-Info-BiologicalMaterial.tab

Tabular Data - 49.9 KB

Published Nov 3, 2022

159 Downloads

20 Variables, 256 Observations UNF:6:xjhU...4SA==

This file contains the description of the genotypes. Briefly, all studied hybrids result from a F1 cross

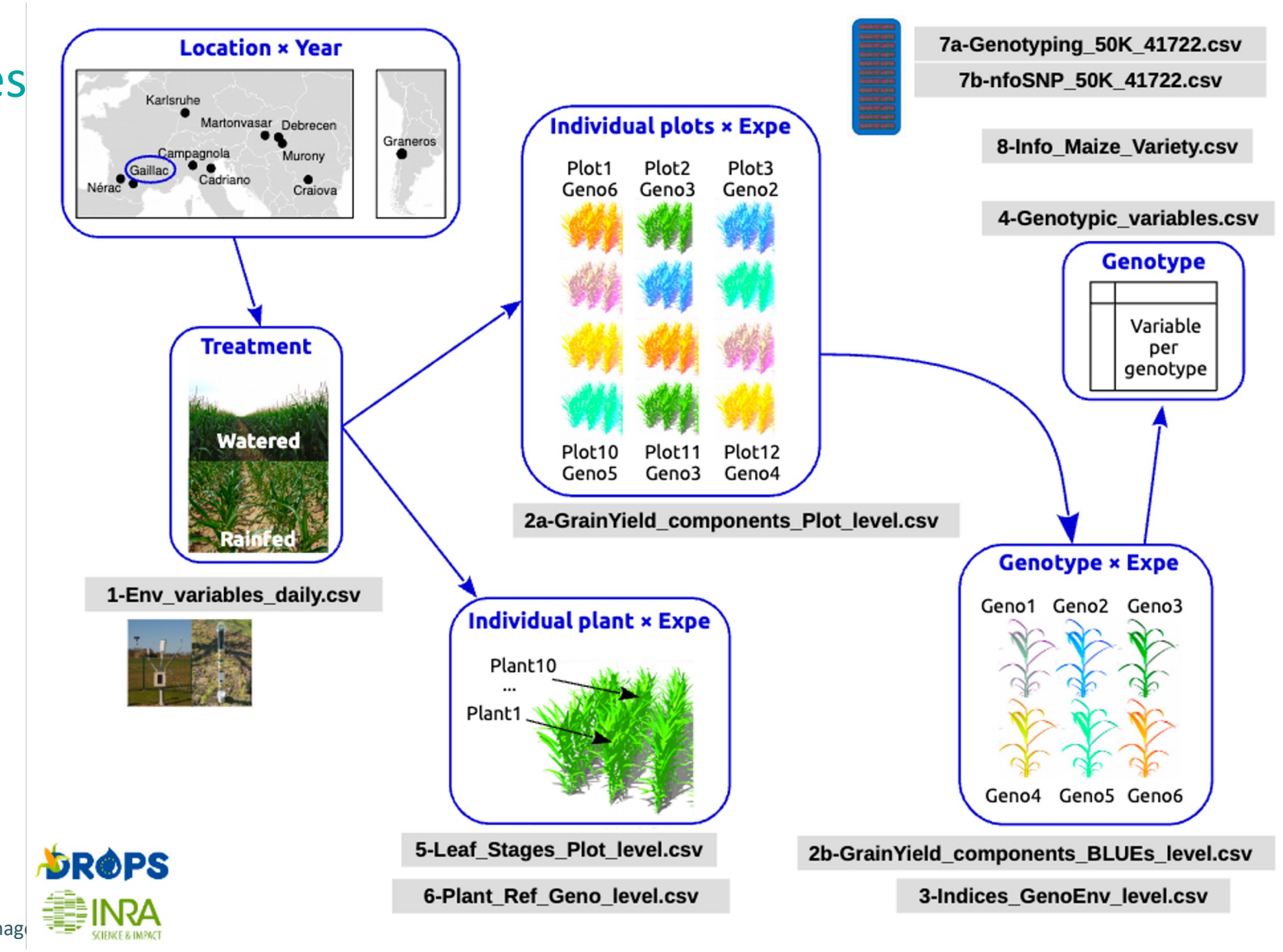
name»: Identifiers of the holing institutions. The Following columns have been added to comply to MIAPPE: "MaterialSourceDOI": DOI of the Accession identifying this variety, "MaterialSourceID": ID of the Accession identifying this variety, "BiologicalMaterialID": ID used in the data files, "Organism":NCBI Taxonomy identifier, "Genus", "Species", "InfraspecificName": variety name

Biological Material

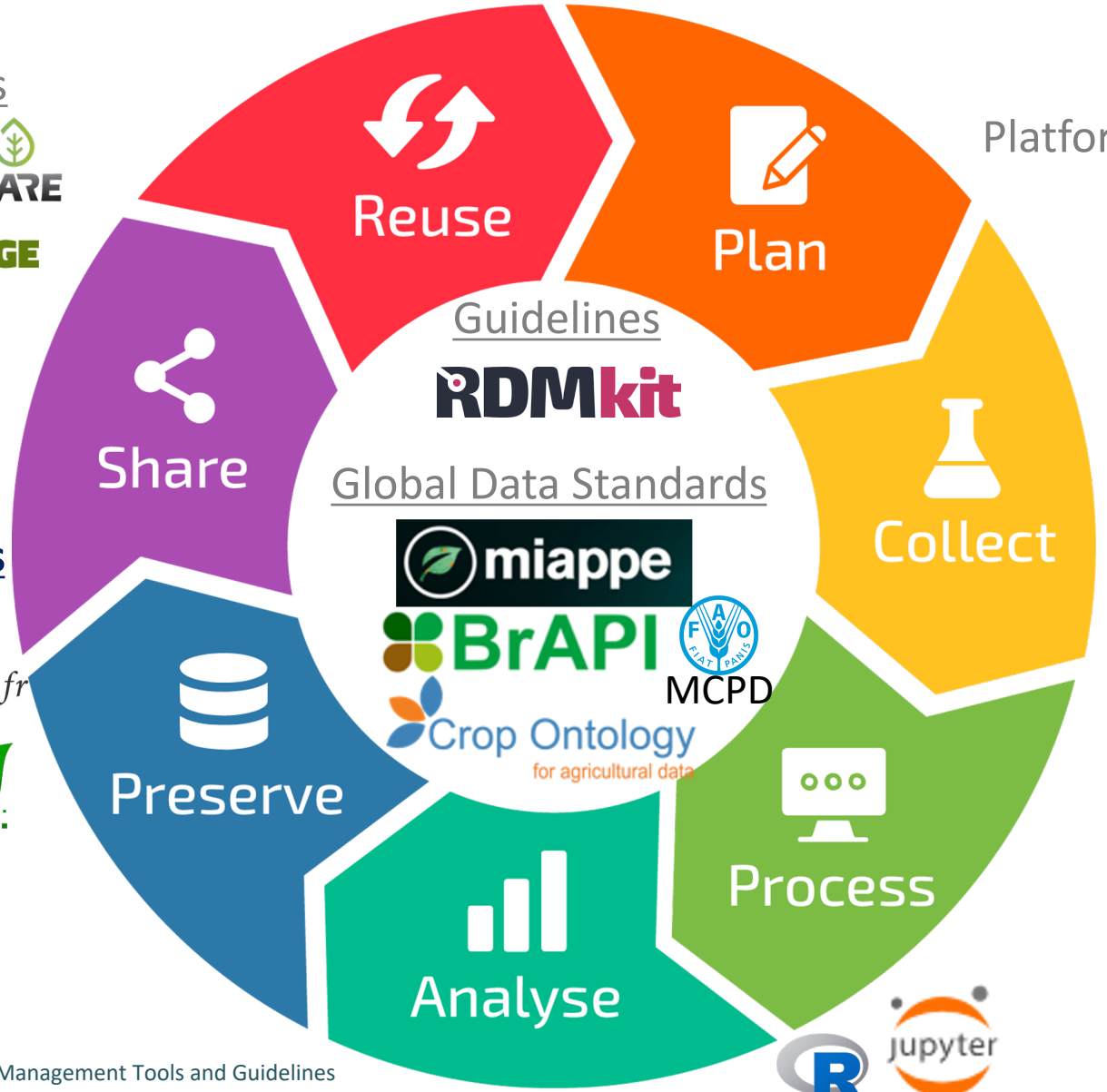
VarietyID	AccessionID	AccessionHolding	MaterialSourceDOI	MaterialSourceID
11430	11430_H	inra	https://doi.org/10.15454/MDSCXQ	inra:11430_H
A3	A3_H	inra	https://doi.org/10.15454/GAHOFA	inra:A3_H
A310	A310_H	inra	https://doi.org/10.15454/CNJTVT	inra:A310_H

Good practice: Human friendly Provenance

Links between files



Overview



Data portals

FAIDARE

FLORILÈGE

Data repositories

The Dataverse Project

recherche.data.gouv.fr

zenodo

EMBL-EBI

PHIS

Platform Information Systems

GRIN-Global

Outil Local de Gestion des Accessions

PHIS

PIPPA

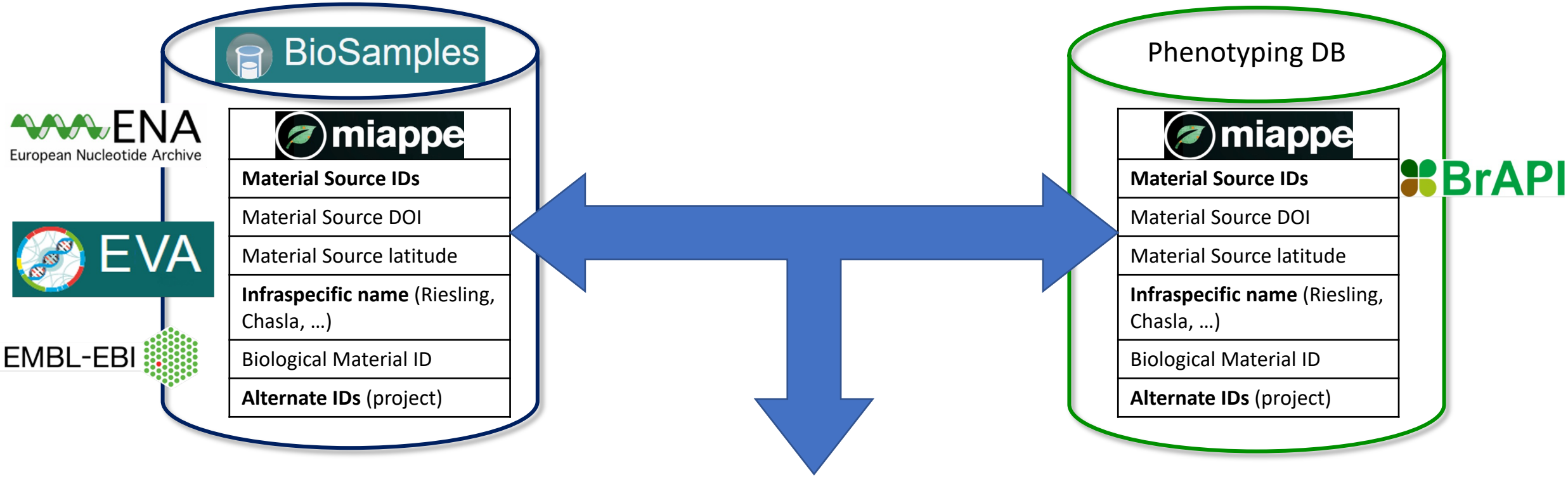
Portable devices, sensors, …

Scripts and Workflows

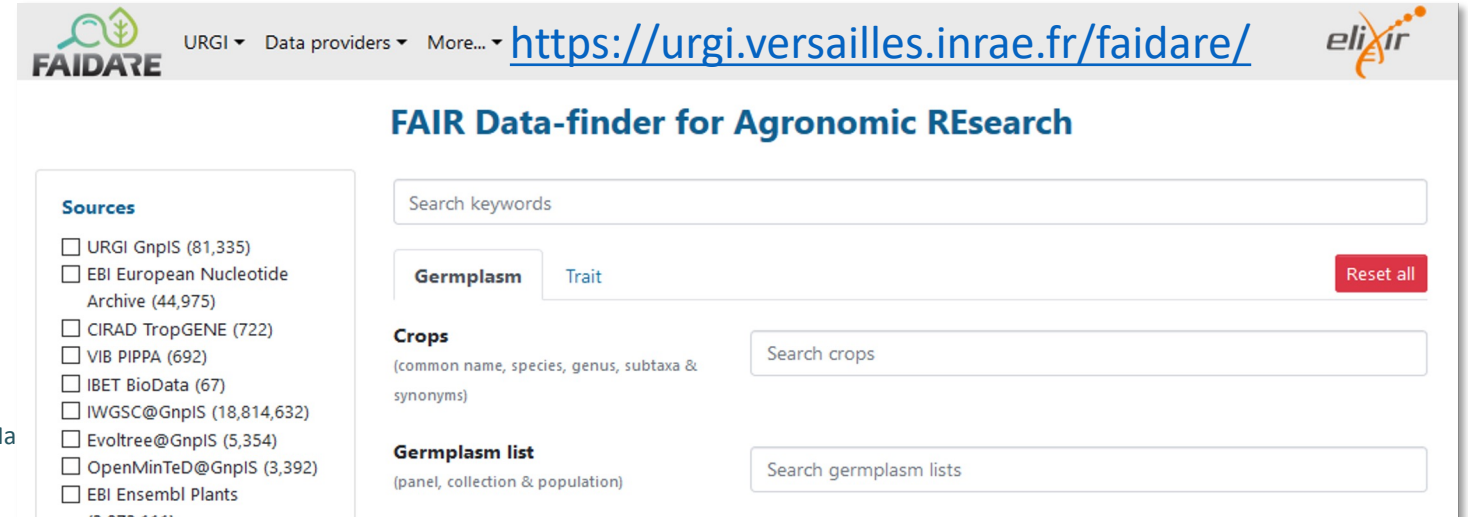
R

jupyter

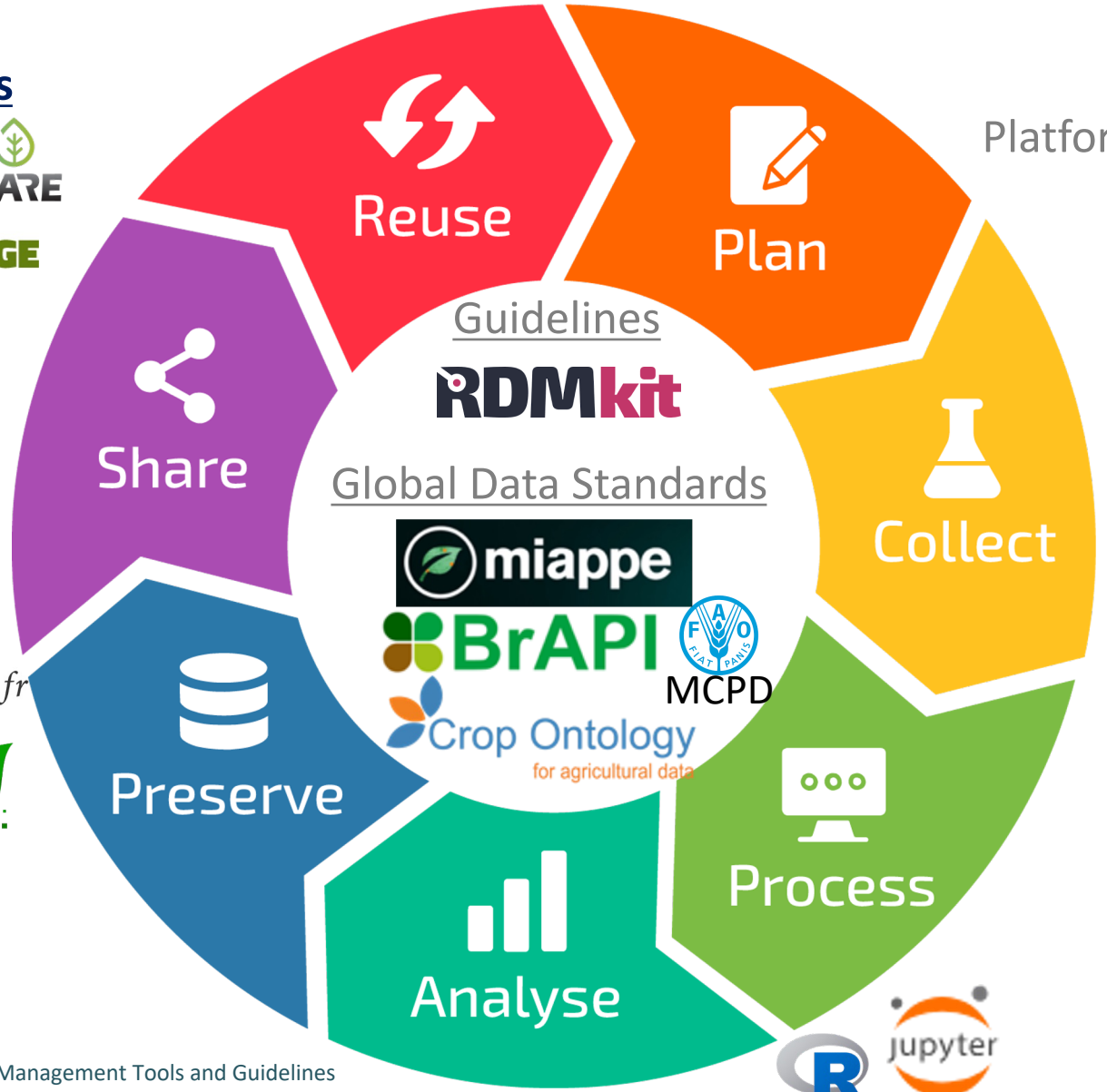
Data Integration between silos, From Phenotyping to Genotyping



Community data discovery portals



Overview



Data portals

FAIDARE

FLORILÈGE

Data repositories

The Dataverse Project

recherche.data.gouv.fr

zenodo

EMBL-EBI

PHIS

Platform Information Systems

GRIN-Global

Outil Local de Gestion des Accessions

PHIS

PIPPA

Portable devices, sensors, …

Scripts and Workflows

R

jupyter

FAIDARE: Global Plant Research Data discovery portal

miappe

Phenomics

EMPHASIS · PHIS · PIPPA · e!DAL · GnpIS

Genetics Genomics

EMBL-EBI

Dataverse

data INRAE

Historical Datadiscovery

WHEAT INITIATIVE

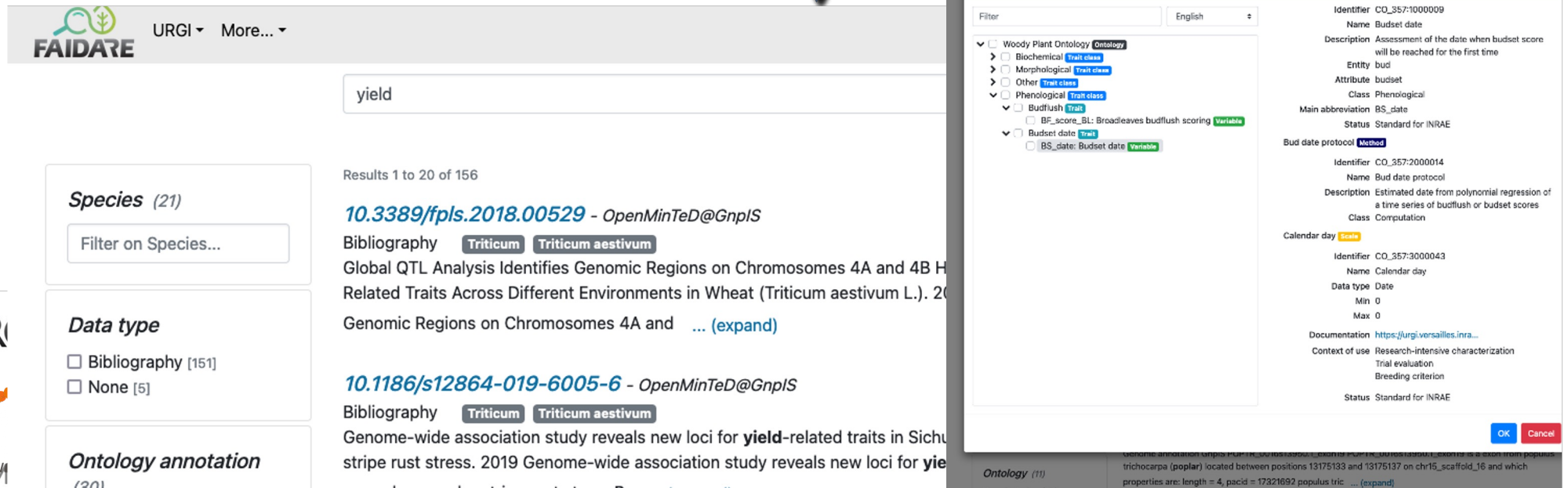
Literature

Europe PMC

Bioschemas sources

BrAPI

https://urgi.versailles.inrae.fr/faidare/



Full text

+

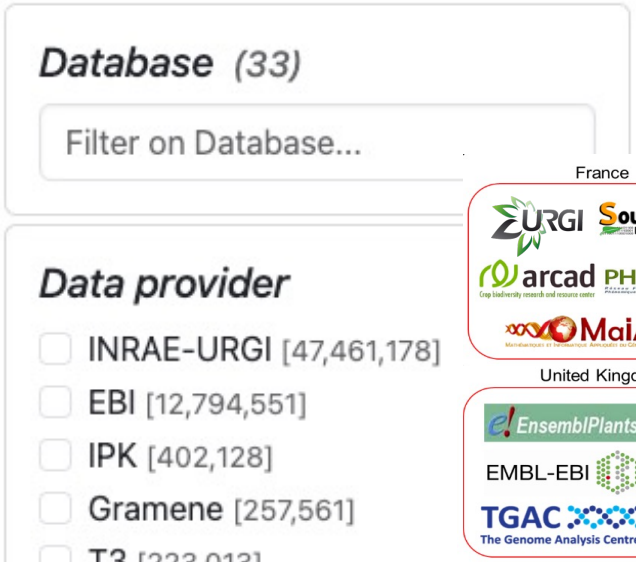
Fine criteria

+

Link back

FAIDARE: Global Plant Research Data discovery portal

- 33 databases indexed all over the world



France

Germany

United Kingdom

Minimal generic
(Data Discovery)

United States

Mexico

BrAPI

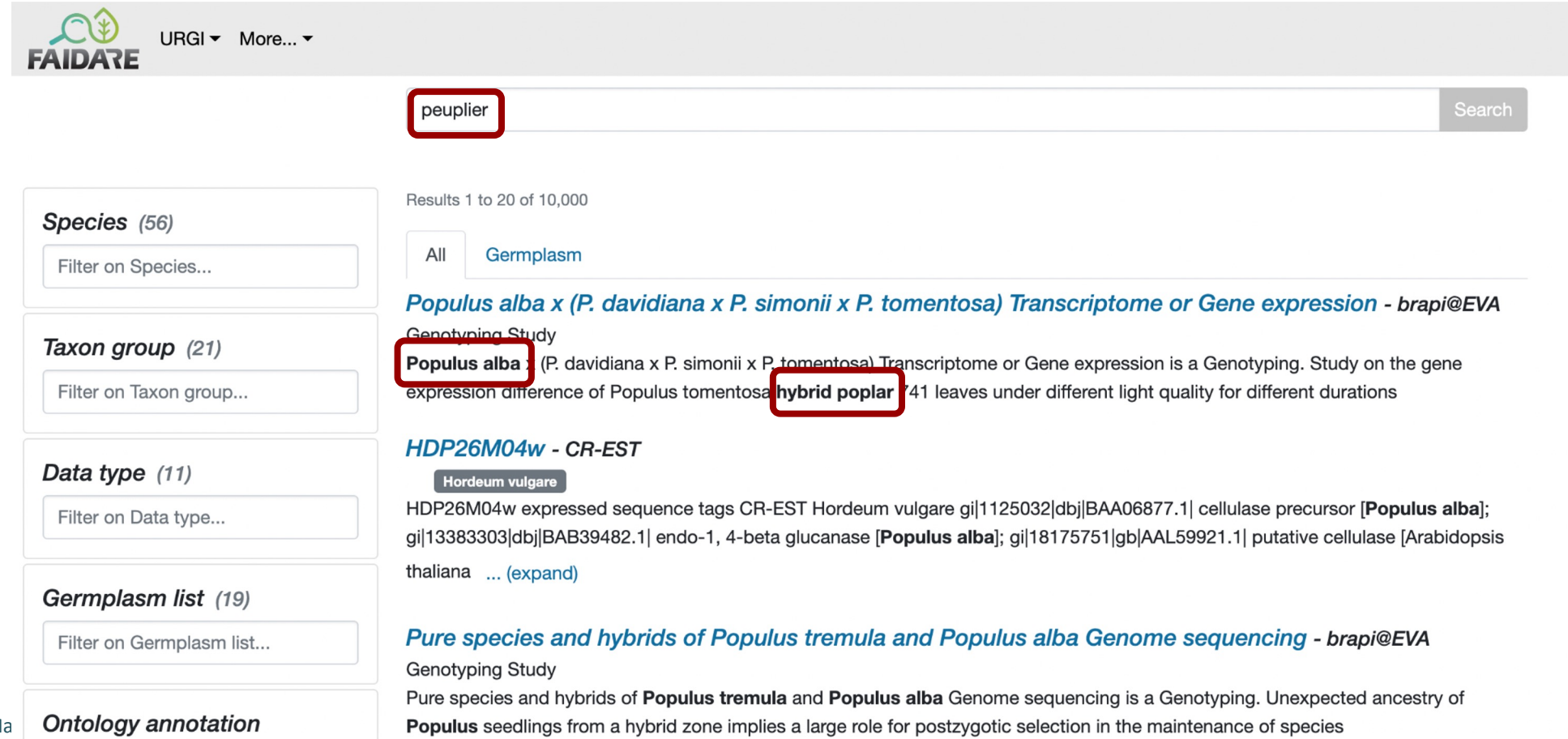
France

Europe

United States

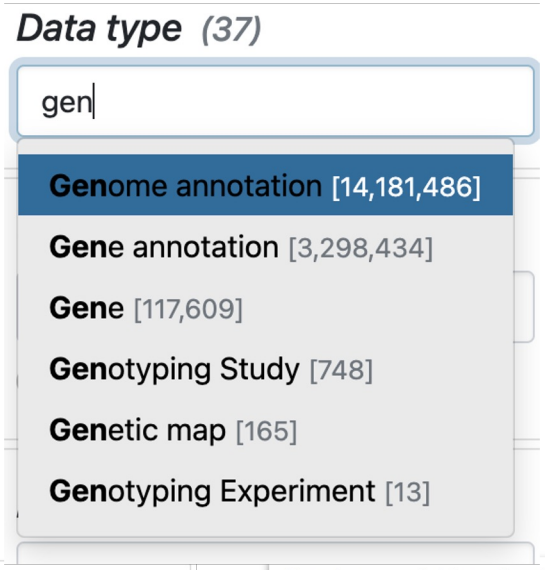
FAIDARE: Global Plant Research Data discovery portal

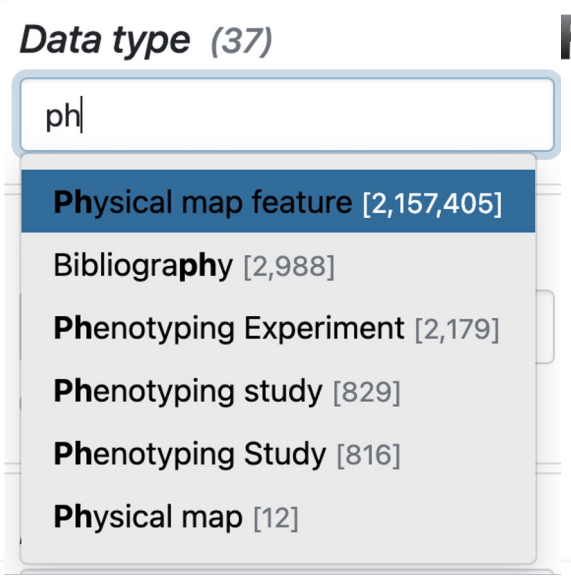
- 33 databases indexed all over the world
- Simple full text search
  - Ontology based synonyms

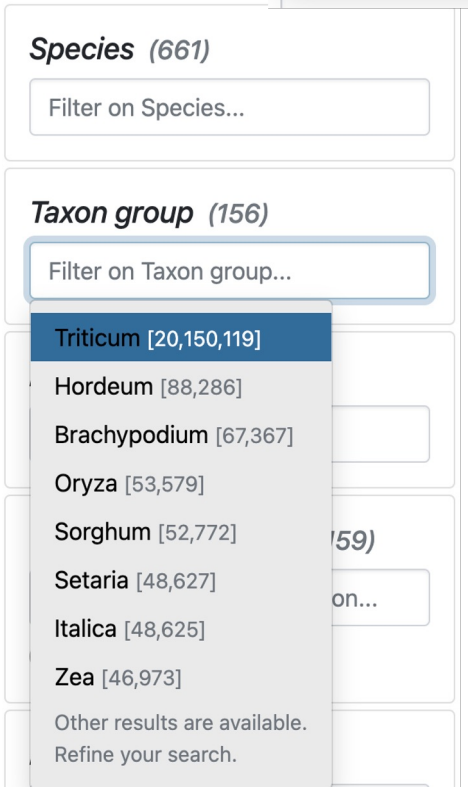


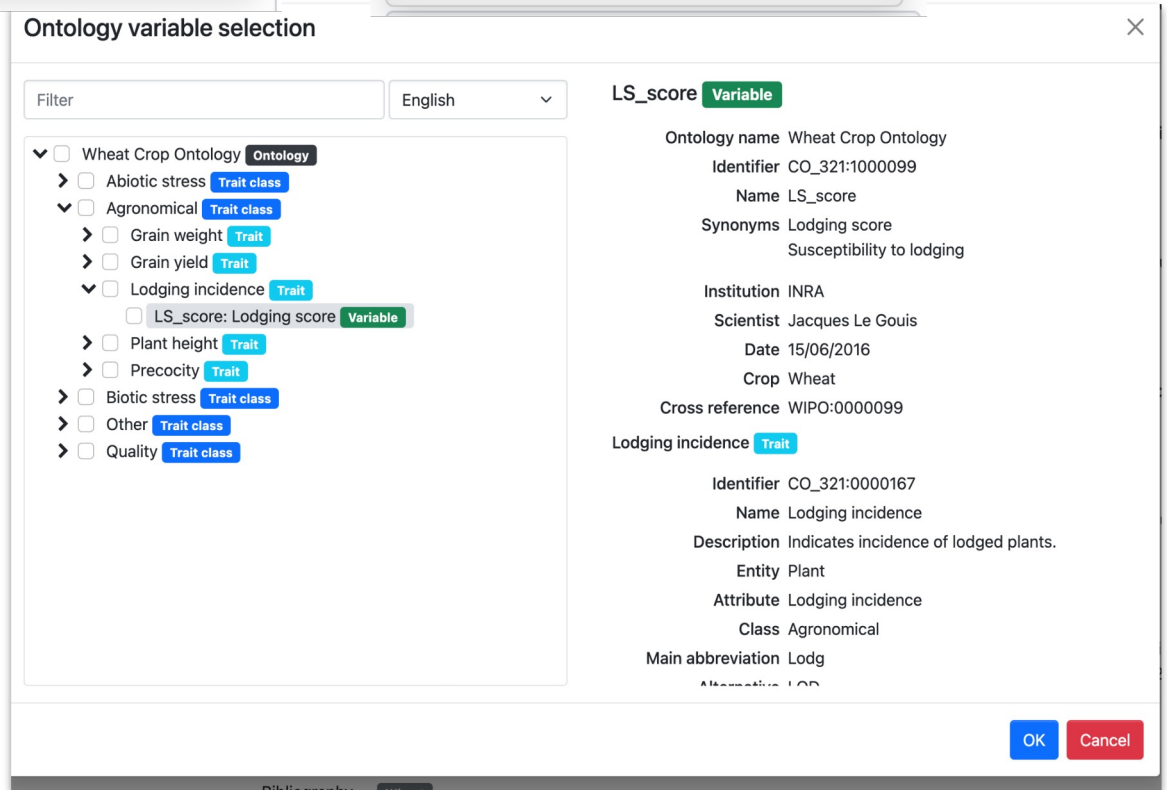
FAIDARE: Global Plant Research Data discovery portal

- 33 databases indexed all over the world
- Simple full text search
  - Ontology based synonyms
- Dedicated filters
  - Data type
  - Taxonomy
  - Genetic resources
  - Crop Ontology
  - Gene Ontology
  - …



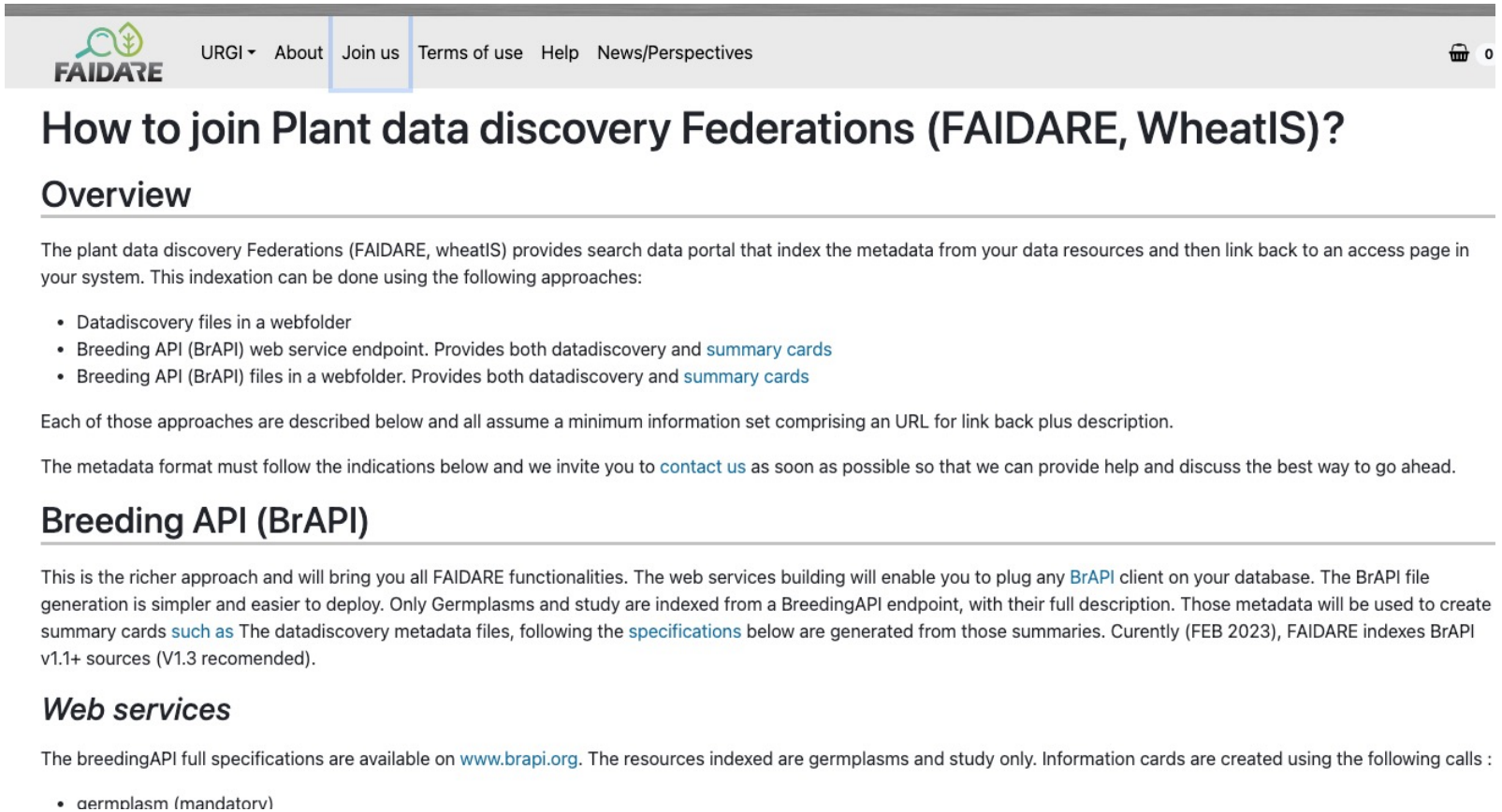






FAIDARE: Global Plant Research Data discovery portal

- 33 databases indexed all over the world
- Simple full text search
  - Ontology based synonyms
- Dedicated filters
  - Data type
  - Taxonomy
  - Genetic resources
  - Crop Ontology
  - Gene Ontology
  - …
- Friendly community managment
  - Join the Federation support



FAIDARE Demonstration

https://urgi.versailles.inrae.fr/faidare/

FAIDARE URGI À propos Rejoignez-nous (EN) Conditions d'utilisation Aide Nouveautés/Perspectives Web services

Study Phenotyping Study: University_of_Bologna Cadriano 2012

Origin site Collecting site Evaluation site Multi-purpose site

Identification

Name	University_of_Bologna Cadriano 2012
Identifier	dXJuOklOUkFFLVVSR0kvc3R1ZHkvQm9sMTI=
Source	GnpIS
Data link	Link to this study on URGI GnpIS

FAIDARE Demonstration

https://urgi.versailles.inrae.fr/faidare/

FAIDARE URGI À propos Rejoignez-nous (EN) Conditions d'utilisation Aide Nouveautés/Perspectives Web services

Study Phenotyping Study: University_of_Bologna Cadriano 2012

Origin site Collecting site Evaluation site Multi-pu

Identification

Name	Univ
Identifier	dXJuOklOUkFFLVVSR0l
Source	GnpIS
Data link	Link to this study on UR

Genotype

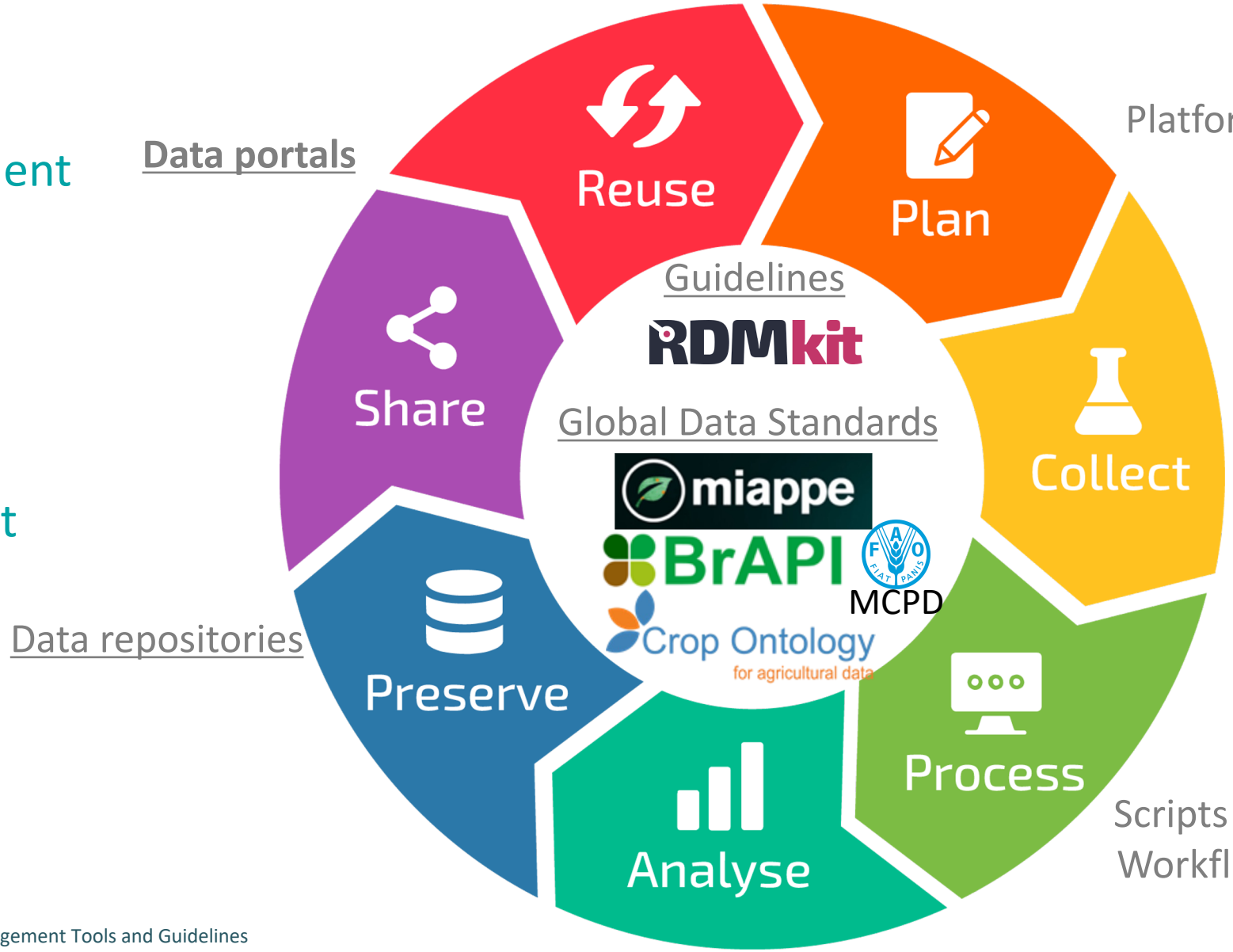
Accession number	Name	Taxon
11430_H	11430_H	Zea may
A310_H	A310_H	Zea may
A347_H	A347_H	Zea may
A374_H	A374_H	Zea may
A375_H		
A3_H		
AS5707_		

Variables

Variable ID	Variable short name	Variable long name	Ontology name	Trait description
EIPO:0000001	Tnight	Night temperature	Environmental Traits	Air night temperatur
EIPO:0000002	Ri	Solar radiation	Environmental Traits	Solar radiation
EIPO:0000003	Psi	Soil water potential	Environmental	Water potential at th

Take home message

- Existing solutions and tools
- Community management
- Interoperability
  - Use cases
  - Data standards
- Global partnerships
- RDM Kit → entry point



Aknowledgments

Elixir Plant community & platforms

Beier S., Gruden C., Pommier C., Coppens F, Scholz U., Lange M., Contreras B., Adam Blondon AF, Faria D, Chavez I, Miguel C, Droedsbek B, Finkers R, Papoutsoglou E, Olster R, Ramsak Z, …

H2020 AGENT

N. Stein (IPK, coord), P. Kersey (RBGK), M. Alaux (INRAE), S. Weise (IPK), C. Pommier (INRAE), M. Lange (IPK), R. Finkers (WUR), *J. Destin (INRAE)*

Crop Ontology

Arnaud E, Laporte MA, …

MIAPPE community

ELIXIR Plant Community,
Krajewsky P, Cwiek H, Tardieu F, Usadel B, Arend D, Arnaud E, Junker A, King G, Laporte MA, Poorter H, Reif J, Rocca-Serra P, Sansone SA, Kersey P,
And many more!

Breeding API

Selby P, Mueller L, Robbins K, Backlund JE, … ,
And many more!

Emphasis

Tardieu F, Usadel B, Arend D, Junker A, Poorter H, Neveu P, Pierushka R, Shur U…
And many more!