

METABO-OPEN 2021
COST Action CA17111

How to describe a grapevine experiment and sample metadata?

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For the Integrape pilot project 1 group



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p. 1

1

> How to describe a grapevine experiment ?

First release: Éric Duchêne (SVQV, INRAE Colmar, France, eric.duchene@inrae.fr) and the participants to pilot project 1 at the 2nd COST Action 17111 Integrape annual meeting in Ljubljana - 5 March 2020.

Further improvements:

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Florian Schwander (JKI Institute for Grapevine Breeding Geilweilerhof, Germany)
Anna Kicherer (JKI Institute for Grapevine Breeding Geilweilerhof, Germany)
Anne-Françoise Adam-Blondon (URGI, INRAE Versailles, France)
Stefania Pilati (Fondazione Edmund Mach, San Michele all'Adige, Italy)
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p. 2

2

➤ How to describe a grapevine experiment ?

Guidelines for Data Management

The scope of these guidelines is to give recommendations to provide meaningful information on experiments, starting with the plant material used. Additionally, we set up an ontology for the organs, some of them being not present in general plant ontologies, as well as some recommendations to describe the phenological stages. This will allow a more accurate and standard description of grapevine biological samples. This will support the grapevine research community in opening its data according to the FAIR principles.

- How to describe an experiment
- How to submit sequence data to ENA
- How to submit metabolomic data to MetaboLights
- How to standardize JBrowse's tracks
- Apollo Manual Curation Guide for the PN40024 v4 assembly (under construction)

<https://integrape.eu/resources/data-management/how-to-describe-a-grapevine-experiment/>

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p. 3

3

➤ How to describe a grapevine experiment ?

How to describe a grapevine experiment

The scope of these guidelines is to give recommendations about standard metadata for experimentation and sampling:

- Metadata about the experiment set up
- Identification of the plant material
- Standard vocabulary for organs or plant anatomical entities
- Standard description of development stages

[Go to Data management](#)

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p. 4

4

➤ How to describe a grapevine experiment ?

The scope of these guidelines is to give recommendations about standard metadata for experimentation and sampling:

- Metadata about the experiment set up
- Identification of the plant material
 - Standardizing the variety name
 - Precise identification of the plant material used in an experiment
- Standard vocabulary for organs or plant anatomical entities
- Standard description of development stages
 - Dates for the main development stages
 - Phenological descriptors for the berries
 - Phenological descriptors for the leaves

This set of recommendations is key for data management of any type of experimentation, phenotyping or genomics. It aims also at guaranteeing interoperability between different datasets obtained from the same plant material.



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p. 5

5

➤ Metadata about the experiment set up, describing the experiment

- Who was in charge of the experiment?
- What were the objectives?
- What were the objects to compare ? What kind of treatments were applied ?
- What was the statistical design?



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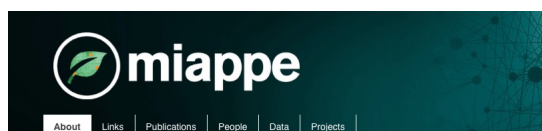
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p. 7

7

➤ Describing the experiment: the MIAPPE project



<https://www.miappe.org>

MIAPPE

Minimum Information About a Plant Phenotyping Experiment

« Defines a list of attributes that might be necessary to fully describe a phenotyping experiment, following the model originally established for microarray data »



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p. 8

8

➤ Describing the experiment: the MIAPPE project

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
DM-3	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 a Major Contribution of the Vgt2 (ZCN6) Locus.	Free text (short)	1
DM-4	Investigation description	Human-readable text describing the investigation in more detail.	The migration of maize from tropical to temperate climates was accompanied by a dramatic evolution in flowering time. To gain insight into the genetic architecture of this adaptive trait, we conducted a 50K SNP-based genome-wide association study (GWAS) investigation on a panel of tropical and temperate American and European representatives.	Free text	0-1
DM-5	Submission date	Date of submission of the dataset presently being described to a host repository.	2012-12-17	Date/Time (ISO 8601, optional time zone)	0-1
DM-6	Public release date	Date of first public release of the dataset presently being described.	2013-02-25	Date/Time (ISO 8601, optional time zone)	0-1
DM-7	License	License for the reuse of the data associated with this investigation. The Creative Commons licenses cover most use cases and are recommended.	CC BY-SA 4.0, Unported	Unique identifier	0-1
DM-8	MIAPPE version	The version of MIAPPE used.	1.1	Version number	1
DM-9	Associated publication	An identifier for a literature publication where the investigation is described. Use of DOIs is recommended.	doi:10.1371/journal.pone.0071377	DOI	0+
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-11	Study unique ID	Unique identifier comprising the name or identifier for the institution/database hosting the submission of the study data, and the identifier of the study in that institution.	EBI:12345678 http://phenome.ipgn.fr/miappe/2013/12351	Unique identifier	0-1

https://github.com/MIAPPE/MIAPPE/blob/master/MIAPPE_Checklist-Data-Model-v1.1/MIAPPE_Checklist-Data-Model-v1.1.1.pdf



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p. 9

9

➤ Describing the experiment: the MIAPPE project

	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" (ie Unwatered), or the "environmental characterisation" (ie if no rain on unwatered plant : Drought ; if rain on unwatered plant: Irrigated)			0+ per study; 0+ per observation unit
PM-60	Experimental Factor type	Name/Acronym of the experimental factor	Watering	Free text (see Appendix II)	1
PM-61	Experimental Factor description	Free text description of the experimental factor. This include all relevant treatments planification and protocol planned for all the plant targeted by a given experimental factor	Daily watering 1 L per plant.	Free text	0-1
PM-62	Experimental Factor values	List of possible values for the factor	Watered; Unwatered	Free text	2+ per factor
PM-63	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/observation unit
PM-64	Event type	Short name of the event.	Planting Fertilizing	Free text (short)	1
PM-65	Event accession number	Accession number of the event type in a suitable controlled vocabulary (Crop Ontology)	CO_715.0000007 CO_715.0000011	Crop Ontology term (subclass of CO_715.0000006)	0-1
PM-66	Event description	Description of the event, including details such as amount applied and possibly duration of the event.	Sowing using seed drill Fertilizer application: Ammonium nitrate at 3 kg/m2	Free text	0-1
PM-67	Event date	Date and time of the event.	2006-08-27T10:23:21+00:00 2006-10-27; 2008-11-13; 2016-11-21	Date/Time (ISO 8601, optional time zone)	1+
PM-68	Observation Unit	Observation units are objects that are subject to particular instances of observation and measurement. An observation unit comprises one or more plants, and their measurement phenomena. Experimental unit is the smallest unit in data files containing the values observed or measured on that unit. Must be locally unique.			1+ per study
PM-69	Observation unit ID	Identify used to identify the observation unit in data files containing the values observed or measured on that unit. Must be locally unique.	plot:894	Unique identifier	1
PM-70	Observation unit type	Type of observation unit in textual form, usually one of the following: block, sub-block, plot, plant, plot, replication or replicate, individual, virtual_trial, unit-parcel	plot	Free text	1

https://github.com/MIAPPE/MIAPPE/blob/master/MIAPPE_Checklist-Data-Model-v1.1/MIAPPE_Checklist-Data-Model-v1.1.1.pdf



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p. 10

10

➤ Describing the experiment: the MIAPPE project

Below are some useful additional items not available in the MIAPPE format:

Technical description of the experiment

- Row and plant spacing
- Rootstock
- Planting date
- Training system
- Soil management techniques
- ...

Cultural operations (facultative)

Cultural operations such as pruning, hedging, fertilizing, pesticide spraying, ... but also applications of experimental factors, can be stored in the "event" sheet.



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p. 11

11

➤ Identification of the plant material

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.		
DM-41	Biological material ID	Code used to identify the biological material in the data file. Should be unique within the investigation. Can correspond to experimental plant ID, seed lot ID, etc... This material identification is different from a BiosampleID which corresponds to Observation Unit or Samples sections below.	INRA:W95115_inra_2001; INRA:inra_kernel_2351; Rothamsted:mes_GK090847	Unique identifier
DM-42	Organism	An identifier for the organism at the species level. Use of the NCBI taxon ID is recommended.	NCBITAXON:4577	Unique identifier
DM-43	Genus	Genus name for the organism under study, according to standard scientific nomenclature.	Zea Solanum	Genus name
DM-44	Species	Species name (formally: specific epithet) for the organism under study, according to standard scientific nomenclature.	mays lycosperum x pennellii	Species name
DM-44	Intraspecific name	Name of any subtaxa level, including variety, crossing name, etc. It can be used to store any additional taxonomic identifier. Either free text description or key-value pair list format (the key is the name of the rank and the value is the value of the rank). Ranks can be among the following terms: subspecies, cultivar, variety, subvariety, convariety, group, subgroup, hybrid, line, form, subform. For MCPD compliance, the following abbreviations are allowed: 'subsp.' (subspecies); 'convar.' (convariety); 'var.' (variety); 'f.' (form); 'Group' (cultivar group).	vinifera Pinot noir B73 subspecies:vinifera ; cultivar:Pinot noir var:B73 subsp. vinifera var. Pinot Noir var. B73	Free text, or key-value pair list, or MCPD-compliant format



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FAO/Bioversity Multi-Crop Passport Descriptors V.2.1 [MCPD V.2.1]

December 2015



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p. 12

12

➤ Identification of the plant material

- Necessity to include a clear name (infraspecific name) , but standardized (Grenache, Tempranillo,...)
- Include a detailed unique identifier and a DOI when possible,



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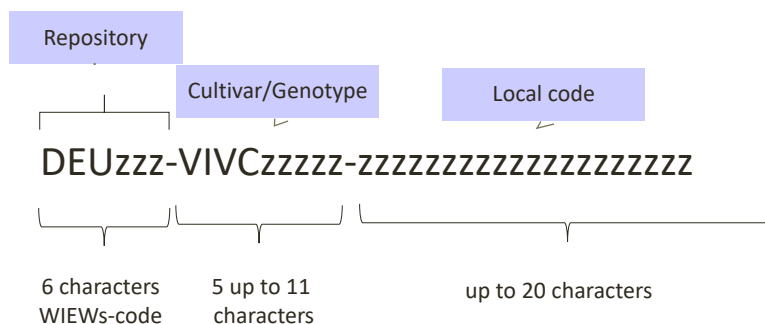


p. 13

13

➤ Identification of the plant material

Developing a unique Identifier for an Accession



➤ Describing the plant material

Field 1 : Code for the institution

Please refer to WIEWS codes from the FAO (<http://www.fao.org/wiews/en/>) or ROR codes (<https://ror.org>) for research organizations.

Field 2: Type of plant material


- the VIVC code with five digits: VIVCxxxxx (<http://www.vivc.de>) for identified varieties
- “PRO” for genotypes from bi-parental crosses
- “TL” for transgenic lines
- “ESL” for lines regenerated from anthers or somatic tissues
- Nothing when the type of plant material is not characterized

Field 3: code used to identify the accession in your institute

Examples

- FRA038_VIVC10077_274Col49 for the clone number 49 of Riesling available at INRAE Colmar.
- FRA038_PRO_41207Col0011E for a genotype in the progeny from a cross between Riesling and Gewurztraminer.
- DEU098_VIVC22828_DEU098-2010-083 and Intraspecific name: Calardis blanc

➤ Describing the plant material: The VIVC database and the WIEWS codes


  **Vitis International Variety Catalogue VIVC**

Home / Holding institutions <http://www.vivc.de>

Holding institutions

Showing 1-9 of 9 items.


Institute code	Institute contact data	Accessions held by the institution
CHE001	Station de recherche Agronomique Changins-Widenswil ACW Route de Dullin 50 1280 Nyon 1 SWITZERLAND	
CHE005	Station Fédérale de Recherches Agronomiques Prestich 105 8820 Wädenswil SWITZERLAND	44
CHE019	Jean-Lucien SPRING Station Fédérale de Recherches en Production Végétale de Changins AGROSCOPE-ARC Avenue de Recherches 21 1000 Fribourg SWITZERLAND	324
CHE063	Georgius BUEFFLER Pöschelhofen	


 **Food and Agriculture Organization of the United Nations**


Google Custom Search

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WIEWS - World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture

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p. 16

16

➤ Standard vocabulary for organs and anatomical entities

Grapevine_Anatomy_Ontology


Fichier Edition Affichage Insertion Format Données Outils Modules complémentaires Aide


Commentaire uniquement


Grapevine anatomy ontology

Initial release: Eric Duchêne - 15/06/2020

Code	Category	Organ	Abbreviation	Synonym	Attributes or qualifiers	CrossRef *	Plant ontology definition *	Specific definition	In French
GAO:10010	Vegetative&reproductive organs	bud	Bud			PO:0000055	An undeveloped shoot system (Pœil, bourgeon)		
GAO:10020	Vegetative&reproductive organs	node	Node			PO:0005004	Cardinal organ part (PO:002500: noeud)		
GAO:20010	Vegetative organs	leaf	Leaf		young, adult	PO:0025034	A phyllome (PO:0006001) that is feuille		
GAO:20011	Vegetative organs	lamina	Lam	blade		PO:0025396	A phyllome lamina (PO:0025396: limbe)		
GAO:20012	Vegetative organs	axial face of the lamina	LamAdFace			PO:0000050	The leaf lamina adaxial epidermis		
GAO:20013	Vegetative organs	abaxial face of the lamina	LamAbFace			PO:0000049	The leaf lamina abaxial epidermis. A portion of leaf lamina		
GAO:20014	Vegetative organs	petiole	Pet			PO:0020038	A stalk (PO:0025066) of a vascular petiole		
GAO:20015	Vegetative organs	leaf abscission zone	LeafAbZ			PO:0006501	An abscission zone (PO:0000146: zone d'abscission de la feuille)		
GAO:20020	Vegetative organs	internode	Intern			PO:0005005	A cardinal organ part (PO:00250: entrenœud)		
GAO:20030	Vegetative organs	shoot	Shoot		young	PO:0009006	A collective plant organ structure (rameau)		
GAO:20031	Vegetative organs	primary shoot	PrimShoot				shoot arising from a primary shoot (rameau primaire)		
GAO:20032	Vegetative organs	secondary shoot	SecondShoot				shoot arising from a secondary shoot (rameau secondaire)		
GAO:20033	Vegetative organs	lateral branch	LatBranch	axillary shoot, summer lateral, prompt		PO:0006343	A shoot-borne shoot (entrecœur)		
GAO:20034	Vegetative organs	sucker	Sucker	water shoot			shoot arising from a sucker (gourmand)		

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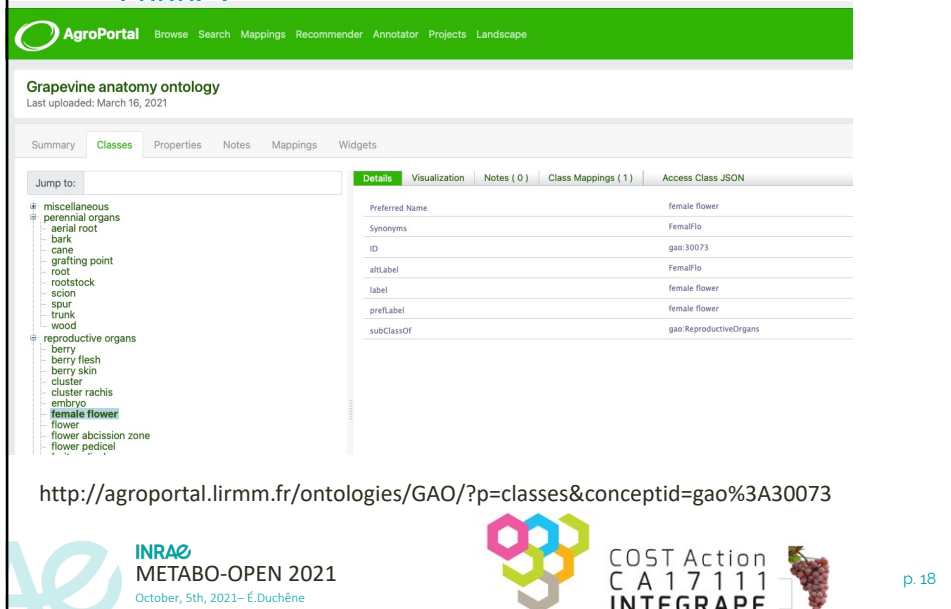
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p. 17

17

➤ Standard vocabulary for organs and anatomical entities



AgroPortal Browse Search Mappings Recommender Annotator Projects Landscape

Grapevine anatomy ontology
Last updated: March 16, 2021

Summary **Classes** Properties Notes Mappings Widgets

Jump to:

- miscellaneous
- perennial organs
 - aerial root
 - bark
 - cane
 - grafting point
 - root
 - rootstock
 - scion
 - spur
 - trunk
 - wood
- reproductive organs
 - berry
 - berry flesh
 - berry skin
 - cluster
 - cluster rachis
 - embryo
 - female flower**
 - flower
 - flower abscission zone
 - flower pedicel

Details	Visualization	Notes (0)	Class Mappings (1)	Access Class JSON
Preferred Name				female flower
Synonyms				FemalFlo
ID				gao:30073
altLabel				FemalFlo
label				female flower
prefLabel				female flower
subClassOf				gao:ReproductiveOrgans

<http://agroportal.lirmm.fr/ontologies/GAO/?p=classes&conceptid=gao%3A30073>

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p. 18

18

➤ Standard description of developmental stages.

A working group in France proposes a protocol (<https://ives-technicalreviews.eu/article/view/2586>) in several languages.

To summarize these recommendations :

- A bud is counted as “broken” **if a green (or red) tip is visible** (BBCH 07, Baggiolini C). The **budbreak date** is determined by interpolation between several successive records, as the day when 50% of the buds left after pruning had reached this stage.
- **For flowering** (BBCH 65, Baggiolini I), the **flowering date** is determined as the day when 50% of the flower caps were detached or fallen.
- **For véraison** (BBCH 85, Baggiolini M), the **most relevant definition is “softening”** and not “color change” in order to record values that can be compared between white and colored genotypes.



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October, 5th, 2021– É.Duchêne

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p. 19

19

➤ Describing the developmental stages

Organ	Green berries
41 days after anthesis	6
47 days after anthesis (before ripening, 4.9 °Brix)	6
5 weeks post-flowering	3
at 40 DAF (green stage)	1
Berries beginning to touch : Bbch 77 (just prior veraison)	15
Berries beginning to touch (Bbch77)	12
E-L 31 (pea-size berries)	2
E-L 33	3
E-L 34	3
EL-33/34 (green hard berry, just pre-veraison)	6
EL-33/34 (green hard berry, just pre-veraison) - 20 hours post treatment	3
EL-33/34 (green hard berry, just pre-veraison) - 24 hours post treatment	3
Green	7
Green berries	6
Green berries the day of veraison	6
Pea-size berries (E-L stage 31)	3
Pea-sized berries : Bbch 75 (almost 20 days after flowering)	15
Pea-sized berries (Bbch 75)	14
Post fruit set (35 DAF ; E-L 32)	3
Post-fruit set (5 weeks post flowering)	2
Post-veraison	1
Pre-veraison	1
Pre-veraison (5-6 weeks post-anthesis)	2
Pre-veraison (5-6 weeks post-anthesis) ; 1 hour post-treatment	2
Pre-veraison (E-L 34)	12
Pre-veraison, majority of berries touching, BBCH 79	36
Veraison (10 weeks post flowering)	2
Young	1



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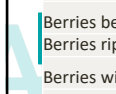
p. 20

20

➤ Describing the developmental stages

Descriptors from 950 RNA-seq datasets

103 days after anthesis (ripening, 22.4 °Brix)	6
121 days after anthesis (late ripening, 25.3 °Brix)	6
20 °Brix	5
20 Brix	23
22 °Brix	5
22 Brix	19
24 °Brix	5
24 Brix	21
26 °Brix	5
26 Brix	21
28 days after mid-veraison (v+28) mid-ripening	12
35 days after mid-veraison (v+35) ripeness	12
68 days after anthesis	6
7 weeks post-flowering	5
74 days after anthesis (early ripening, 17.5 °Brix)	6
93 days after anthesis	6
at 65 DAF (veraison)	1
at 90 DAF (ripe stage)	1
Berries beginning to color and enlarge (E-L stage 35)	2
Berries ripe for harvest (Bbch 89)	27
Berries with intermediate Brix values (E-L stage 36)	4
Berries maturity (v+248Brix)	20



p. 21

21

➤ Standard description of developmental stages

A proposal for the berries:

- Clearly make the difference between green berries, ripening berries, post-harvest berries
- For green berries: days after flowering, and/or days before véraison
- For ripening berries, by priority:
 1. Days after véraison,
 2. Total soluble solids (TSS) in ° Brix
 3. Heat sums (base 10°C) after véraison,
 4. pH
 5.



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p. 22

22

➤ Standard description of developmental stages.

A proposal for the leaves:

- Age (number of leaves from the apex)
- Position (from the base of the shoot)
- (Total number of leaves on the shoot)
- Type of shoot (primary, secondary, lateral)



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p. 23

23

➤ To conclude

- We propose here some guidelines to make grapevine experiments more comparable and reusable,
- These recommendations can be further improved
- Try them, use them and give us some feedbacks



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p. 24

24

➤ Thank you for your attention



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25