

MIAPPE v1.1 proposal for assessment

An extended set of recommendations for metadata and phenotypic data annotation was developed by the EXCELERATE work package 7 team based on the publicly available version of MIAPPE (Ćwiek-Kupczyńska et al. 2016; DOI: 10.1186/s13007-016-0144-4), as presented below. Some attributes have been edited and new ones added. The main lines of these proposed changes are summarized below:

- Study metadata section : Attributes, definitions and mandatory status aligned on DOI metadata instead on “Default ISA-Tab list for terms and mandatory fields”
- Biosource section: here we aligned further to MCPD, while being non-redundant with details that would be stored in genebanks catalogs. We also aimed at being more generic and include some forest trees specificities for the identification of the plant material.
- Environment sections: most attributes are not mandatory anymore to keep generic across different types of experiments
- Experimental design section: the section has been revised in depth to take into account when relevant ISA-tab vocabulary but also Important description elements for field experiments of crops and forest trees, and for greenhouse experiments
- Sample collection section: samples attributes have all been grouped here and aligned with BioSample specifications that also have been revised in parallel. The objective is to improve the interoperability between phenotyping and genomic/genotyping experiment made on the same accessions/varieties.
- Observed Variables section: this section has been completely revised to be aligned with the Crop Ontology’s specifications.

More details of the changes he details can be seen in column H of the working document from which this proposal was prepared: <https://docs.google.com/spreadsheets/d/1SiUVvauhdNSpAfHqds-vQpjAXYs34IFD8wSOZdkyCgY/edit#gid=989837895>.

Definition for Attributes in each of the 10 sections (Study metadata, Timing and location of study, Biosource, Environment-growth facility, Environment-rooting conditions, Environment-nutrients, Treatments, Experimental design, Sample collection, processing and management, Observed variables) were included, as well as examples and ontologies/data types that should be used to describe the attributes. Some general guidelines are also provided below for a consistent use of the standard.

Conventions for the Sample MIAPPE metadata:

- 1) If there is a "**Derived Material**" attribute, it should be unique in each sample of the investigation
- 2) If there is not unique value or non-existent values for "**Derived Material**", then the "**Material Source**" should be unique per sample in the investigation UNLESS in the investigation there are time series
- 3) For trees: if there is value for either **latitude** or **longitude** there should be value for both.
- 4) For trees: if there is value for **altitude** there should be value for all three: **latitude, longitude and altitude**.
- 5) for the definition of the ontologies, the FULL URL of the term is expected
- 6) "**Material Source**" and "**Derived Material**" cannot have the same value in 1 sample
- 7) The "**Environment: XXX**" sections should describe the environmental parameters that are measured but are not modified as an experimental factor
- 8) The "**Treatment**" section should describe a plant experimental condition (EO:0007359) or set of conditions describing the application of an abiotic (EO:0007191) or biotic plant treatment (EO:0007357) or the combinatorial application thereof. The treatment (or Factor) is declared and described at the study level (e.g. Experimental field X) and varies in the different assays of the study (e.g. different plots or plants in the experimental field).

MIAPPE Check list	Definition	Example	Ontology/data type
Study metadata			
Unique identifier of study¹	Key-value pair comprising the unique name of the institution/database hosting the submission of the study data, and the identifier of the study in that institution. To be filled by the submitter	EBI:12345678	xsd:string
Submission date*	Date of submission of the study data to the host institution (given by the host database)	02-26-2006	xsd:date
Title of study*	Human readable string summarising the study	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 (ZCN8) Locus	xsd:string

Description of study¹	Human readable string describing the study	Time series response of potato cv. Désirée, which is tolerant to PVY infection, was analysed in both inoculated as well as upper non-inoculated leaves. Additionally, transgenic plants deficient in accumulation of salicylic acid (NahG-Désirée) were studied in the same setting.	xsd:string
Public Release date*	Date of first public release of the study data. This is filled in by the database when the submission becomes public	02-30-2006	xsd:date
Associated publication/s	DOI of literature publication where the study is described	DOI: 10.1186/1471-2229-13-123	DOI
Name and address of the laboratory*	Name and address of the laboratory where the study took place	Forest Biotech Lab, IBET, Av. da República, Quinta do Marquês, 2780-157 Oeiras Portugal	xsd:string
Data submitter contact (email)	The mail address of the data submitter	ichaves@itqb.unl.pt	xsd:string (valid email address)
Data submitter identifier	The ORCID id of the data submitter	orcid.org/0000-0002-7054-800X	ORCID id
Study data file link	This is Study level metadata. It is the link to the data files of the study in the appropriate database	http://www.ebi.ac.uk/arrayexpress/experiments/E-GEOD-32551/	xsd:anyURI
Timing and location of study			
Timing: start of study*	Date and, when relevant, time on which the experiment started	09-27-2006	xsd:dateTime
timing: end date of study	Date and, when relevant, time on which the experiment ended	12-27-2006	xsd:dateTime
Geographic location of study (country)*	Defines the country/ies where the experiment took place (list-valued attribute)	Porto (Portugal), Cambridge (UK)	Geonames
Experimental site name	Natural site/experimental field/greenhouse/phenotyping facility name where the experiment took place (if applicable)	Thurso research station, north field / redwood forest, California, USA	xsd:string
Geographic location of study (latitude)*	Degrees and minutes followed by north (N) and south (S) of the natural site/experimental field/greenhouse/phenotyping facility where the experiment took place. This can be a random GPS location of the site or the GPS of its entrance.	39°4'N	xsd:string
Geographic location of study (longitude)*	Degrees and minutes followed by east (E) and west (W) of the natural site/experimental field/greenhouse/phenotyping facility where the experiment took place	8°44'W	xsd:string

Geographic location of study (altitude)	Elevation expressed in meters (m) above sea level of the natural site/experimental field/greenhouse/phenotyping facility where the experiment took place	100 m	xsd:string
Biosource			
Organism*	The taxon id of the species as defined by NCBI	4577	NCBI Taxonomy id
Infraspecific name	Key (name of the rank): value (value of the rank) pairs. Ranks can be among the following terms: subspecies, cultivar, variety, subvariety, convariety, group, subgroup, hybrid, line, form, subform	subspecies:vinifera;cultivar:Pinot noir	xsd:string
Time factor	Significant date and time, e.g. planting date. key-value pairs to describe the type of date.	http://www.croponology.org/terms/CO_715:0000033:04-06-2010	Crop Ontology:'CO_715:0000006' + xsd:dateTime
Life stage	Describes the life stage of the sample at the time of the experiment. Takes values of BBCH scales or PO ontology	http://www.croponology.org/terms/PO:0009009;BBCH-17	BBCH / Plant Ontology
Material Source: Holding Institute/Stock Centre, accession*	Key value pairs of holding Institute (institute/database that gives the accession number or name), accession number or name (describes a record in a genebank or laboratory). In forestry, provenance or region of provenance may be used when accession is not available. Naming of accessions derived from sexual reproduction in plants:: "mother_accession X father_accession". Only 2 parents allowed only ; if father is unknown, format is "mother_accession X UNKNOWN".	INRA:W95115_inra ; ICNF:PNB-RPI	xsd:string
Material source: DOI	Digital Object Identifier (DOI) of the accession or provenance for trees	doi:10.15454/1.4658436467893904E12	DOI
Derived Material¹	Key-value pair of derived material identifier and holding institute (institute that gave the identifier to the derived material) ; derived material from an accession: seed or plant lots, any sample collected on or from the accession and that has been phenotyped.	INRA:W95115_inra_2001;INRA:inra_keruel_2351;Rothmasted:rres_GK090847	xsd:string
Treatment	Treatment/s made for all the samples of the study	http://purl.obolibrary.org/obo/EO_0007210:PVY(NTN);	Plant Environment Ontology + xsd:string
Derived material for trees: Geographic location (latitude)	Degrees and minutes followed by north (N) and south (S) of the location of the source sample	39°4'N	xsd:string
Derived material for trees:	Degrees and minutes followed by east (E) and west (W) of	8°44'W	xsd:string

Geographic location (longitude)	the location of the source sample		
Derived material for trees: Geographic location (altitude)	Elevation expressed in meters (m) above sea level of the location of the source sample	10 m	xsd:string
Environment: Growth facility			
Type of growth facility*	Environment in which the trial or experiment or characterization or evaluation is carried out.	field environment condition; greenhouse environment condition; greenhouse then field condition; growth chamber (GC)	Crop Ontology: "CO_715:0000005"
Average day temperature	The air temperature during the day (light conditions).	22 °C	xsd:float
Average night temperature	The air temperature during the night (dark conditions)..	18 °C	xsd:float
Change over the course of experiment	Difference between the maximum air temperature recorder and the minimum.	0.75 °C	xsd:float
Average daily integrated photosynthetic photon flux density (PPFD) measured at plant or canopy level.	Photosynthetic photon flux density (PPFD) over a 24-h period	plant PPFD: 61 mol m ⁻² d ⁻¹ ; canopy PPFD: 40 mol m ⁻² d ⁻¹	xsd:string
Average length of the light period	Average length of the light period in h.	16	xsd:float
Light intensity	Intensity of total light	[μmol m ⁻² s ⁻¹]	xsd:float
Range in peak light intensity	Range in peak light intensity.	[μmol m ⁻² s ⁻¹]	xsd:float
Fraction of outside light intercepted by growth facility components and surrounding structures	Fraction of outside light intercepted by growth facility components and surrounding structures.	[μmol m ⁻² s ⁻¹]	xsd:float
Type of lamps used	Nature of the light source for controlled environments. XEO: 00137	fluorescent tubes; high intensity discharge (HID) lamps; light emitting diodes (LED)	xsd:string
R/FR ratio	Red light to far red light ratio. XEO:00036	[mol mol ⁻¹]	xsd:float
Daily UV-A radiation	Defines the intensity of UVA radiation (320-400 nm);	[W m ⁻²]	xsd:float

	XEO:00037		
Daily UV-B radiation	Defines the intensity of UVB radiation (290-320 nm); XEO:00038	[W m-2]	xsd:float
Total daily irradiance	Defines the intensity of total light (XEO:00034).	[W m-2]	xsd:float
Atmospheric CO2 concentration	Denotes whether the atmospheric CO2 concentrations were controlled during the experiment.	controlled; uncontrolled	xsd:float
Average CO2 during the light and dark periods	Defines the concentration of CO2 in the air during the light and dark periods (XEO:00023)	light period: 390 mL-1; dark period: 450 mL-1	xsd:string
Average VPDair during the light period	The Vapour Pressure Deficit in the air defines the difference between the maximal amount of water in the air minus the actual amount during the light period in kPa (XEO:00021)	2 kPa	xsd:float
Average relative humidity during the light period	The relative humidity describes the amount of water vapor in the air, generally expressed as the percentage of the maximum water vapor during the light period (XEO:00020)	30%	xsd:float
Average VPDair during the dark period.	The Vapour Pressure Deficit in the air defines the difference between the maximal amount of water in the air minus the actual amount during the dark period in kPa ((XEO:00021)	2.7 kPa	xsd:float
Average relative humidity during the dark period	The relative humidity describes the amount of water vapor in the air, generally expressed as the percentage of the maximum water vapor during the dark period (XEO:00020)	33%	xsd:float
Environment: Rooting conditions			
Rooting medium	An abiotic plant treatment (EO:0007191) involving the use of a solid or liquid substrate for growing plants or tissue-cultured plant samples.	hydroponic plant culture media; in vitro liquid growth medium; in vitro solid growth medium; soil environment	Plant Environment Ontology:'EO_0007147'
Container type	Defines the type of container used to grow/treat the plants.XEO:00040	pot; Petri dish; well; tray	xsd:string
Container volume	Defines the volume that is available to the roots. XEO:00113	[L]	xsd:float
Container height	Defines the height of the container.	[m]	xsd:float
Number of plants per containers	Defines the number of plants per container. XEO:00112	X/container	xsd:integer
Plot size	Description of experimental sites.	higher-level landform; land element and position; slope;	Crop Ontology:'CO_715:0000 058'
Sowing density	Sowing density.	x/plot	Natural Resource and

			Environment Ontology
Rooting medium replenishment	Frequency and volume of replenishment or addition of the rooting medium.		xsd:string
pH	Value of soil pH, separated by a colon, the depth (cm) from where soil sample was taken. Multiple values are separated by semicolon. For hydroponics, leave the depth empty.	7.7:40-60; 6.5; 4.3:10-20	xsd:string
Porosity	A permeability quality inhering in a bearer by virtue of the bearer's disposition to admit the passage of gas or liquid through pores or interstices. PATO:0000973	[%]	xsd:float
Medium temperature	Temperature of the replenishment medium.	[°C]	xsd:float
Soil penetration strength	Soil penetration strength as measured by the standard penetration test (SPT; ISO 22476-3), the cone penetrometer test (CPT), in-situ vane shear tests, and shear wave velocity measurements.	[Pa m ⁻²]	xsd:float
Water retention capacity	Defines the potential energy of water per unit mass of water in the soil.XEO:00126	[g g ⁻¹ dry weight]	xsd:float
Organic matter content	Proportion of organic matter in the soil. XEO:00117	[%]	xsd:float
Environment: Nutrients			
Médium composition	Concentration of the nutrients	Ca (XEO:00058): 5 mg/L	XEML Environment Ontology:'XEO_00042' +xsd:float
Extractable N content per unit ground area before fertiliser added	Extractable N content per unit ground area before fertiliser added	[mg/m ²]	XEML Environment Ontology:'XEO_00054' +xsd:float
Type and amount of fertiliser added per container/m²	The current practice in field /greenhouse management for fertilization	nitrogen: [concentration]; phosphorus: [concentration]	Crop Ontology:'CO_715:0000204' +xsd:float
Concentration of [nutrient] before start of the experiment	Concentration of a nutrient at the start of an experiment.	Ca (XEO:00058): 5 mg/L	XEML Environment Ontology:'XEO_00042' +xsd:float
Extractable N content per unit ground area at the end of the experiment	Extractable N content per unit ground area at the end of the experiment	[mg/m ²]	XEML Environment Ontology:'XEO_00054' +xsd:float
Volume and frequency of	A defined volume of water supplied to pots of a	[L/m ²]	xsd:float

water added per container/m2	defined size.		
Matrix potential	Range in water potential for soil.	-10 to -30 kPa	xsd:float
Watering regimen	The treatment involving an exposure to watering frequencies.	irrigation from top; irrigation from bottom; drip irrigation	xsd:string
Composition of nutrient solutions used for irrigation	For all nutrients, the ontology term with concentration.	Ca (XEO:00058): 5 mg/L	XEML Environment Ontology:'XEO_00042' + xsd:float
Composition of the salts	For all nutrients, the ontology term with concentration.	[mol L-1]	XEML Environment Ontology:'XEO_00042' + xsd:float
Electrical conductivity	A conductivity quality inhering in a bearer by virtue of the bearer's ability to convey electricity.	[dS m-1]	xsd:float
Treatments			
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'
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'
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'
Soil treatment regime	The treatment (EO:0007049) involving growing plants and exposing them to soil growth media with varying contents	sand content (10% v/v)	Plant Environment Ontology:'EO_0007161'
Antibiotic regime	A chemical treatment (EO:0007189) involving the use of antibiotic for selection purposes.	actinomycin D; 20mM;20ml per plant; Every week	Plant Environment Ontology:'EO_0007041'
Chemical administration	An abiotic plant treatment (EO:0007191) involving the application of chemical(s).	Bion; 13,5mM; 5ml per plant; Every 15 days.	Plant Environment Ontology:'EO_0007189'
Biotic treatment	A plant treatment (EO:0001001) involving the application of a biotic or biological factor such as a microbe, insect, animal, or plant or a combination thereof	rice tungro bacilliform virus (RTBV) 2.5 µl, incubated at room temperature for 10min	Plant Environment Ontology:'EO_0007357'

Fertilizer regime	A plant nutrient treatment (EO:0007241) involving the use of a fertilizer, a combination of plant nutrients.	Potassium phosphate; 50 Kg P.Ha/y 50 Kg K.Ha/y	Plant Environment Ontology:'EO_0007085'
Fungicide regime	A treatment (EO:0007167) involving the application of a fungicide; a chemical entity or mixture of chemical entities.	Benzothiadiazole; 10mM; 1ml; Every month	Plant Environment Ontology:'EO_0007268'
Gaseous regime	A physical plant treatment (EO:0007316) involving the application of a gas or a combination of gasses.	Carbon Dioxide; 20ppm	Plant Environment Ontology:'EO_0007023'
Gravity	The treatment involving use of gravity factor to study various types of responses in presence, absence or modified levels of gravity.	Zero gravity (International space station)	Plant Environment Ontology:'EO_0007146'
Growth hormone regime	A chemical treatment (EO:0007189) involving the use of growth hormones to study various types of responses on their extrinsic and/or intrinsic application.	Jasmonic acid; 1mM;20ml;	Plant Environment Ontology:'EO_0007165'
Herbicide regime	A treatment (EO:0007167) involving the application of a herbicide; a chemical entity or mixture of chemical entities.	SUREWET (Polyvinyl polymer and nonionic surfactant); 1,75mM; 5ml per plant; Sprayed every month	Plant Environment Ontology:'EO_0007183'
Mechanical treatment	A treatment involving the application of a mechanical force	Wounding, bending	Plant Environment Ontology:'EO_0007373' / xsd:string
Mineral nutrient regime	A chemical treatment (EO:0007189) involving the application of inorganic chemical(s).	Cd 0.5 mg/L (Hydroponics), CdCl ₂ 15mg.Cd/kg (soil)	Plant Environment Ontology:'EO_0007044'
Humidity regimen	A treatment involving an exposure to varying degree of humidity, which may depend on regional environment.	56%/70% (Day/Night)	Plant Environment Ontology:'EO_0007359'
Non-mineral nutrient regimen	Treatment involving the exposure of plant to molecular forms of nutrient as supplement to study various types of responses.	Low Carbon - Sucrose concentration	Plant Environment Ontology:'EO_0007043'
Radiation (light, UV-B, X-ray) regime	A physical plant treatment (EO:0007316) involving an exposure with a radiation type, intensity or quantity. EMR is classified according to the frequency of its wave. The electromagnetic spectrum, in order of increasing frequency and decreasing wavelength, consists of radio waves, microwaves, infrared radiation, visible light, ultraviolet radiation, X-rays and gamma rays. (from Wikipedia).	200-280nm; 30min; every day	Plant Environment Ontology:'EO_0007151'

Rainfall regime	Treatment involving an exposure to a given amount of rainfall.	79 rainfall events; 15,6mm (mean size)	Plant Environment Ontology:'EO_0007181'
Salt regime	This treatment may be used to simulate the growth conditions of sea coast regions and saline/sodic soils. A chemical treatment (EO:0007189) involving use of salts as supplement to liquid and soil growth media to study various types of responses on their application.	150mM	Plant Environment Ontology:'EO_0007185'
Watering regime	Treatment involving an exposure to watering frequencies.	20ml every 3 days	Plant Environment Ontology:'EO_0007383'
Water temperature regime	Treatment involving an exposure to water with varying degree of temperature, which may depend on regional environment.	20°C	Plant Environment Ontology:'EO_0007160'
Standing water regime	The treatment involving an exposure to standing water during a plant's life span. This also results in anaerobic soil conditions for either long or short periods.	Flooding water, Deep water	Plant Environment Ontology:'EO_0007282'
Pesticide regime	A chemical treatment (EO:0007189) involving the application of a pesticide; a chemical entity or mixture of chemical entities.	Glyphosate; 1.68 kg acid equivalent (a.e.) / ha	Plant Environment Ontology:'EO_0007167'
pH regime	The treatment involving exposure of plants to varying levels of pH of the growth media.	acidic pH soil environment	Plant Environment Ontology:'EO_0007171'
Other perturbation			xsd:string
Experimental design			
Spatial coordinates: ID	name of the column head of the data file giving the spatial coordinates of an assay in the study	ex: latitude, longitude or X, Y	xsd:string
Spatial coordinates: type	georeference or line/column	can be repeated: ex: long, lat	xsd:string
Unit Spatial coordinates: unit	Unit used to describe the spatial coordinate of an assay in the study (e.g.degree, minute, number)		xsd:string
Time coordinates - ID	Times series or cinetics: name of the column head giving the time at which a set of measures has been collected		xsd:string
Time coordinates - Unit	Times series or kinetics: unit of time used	can be repeated. Date Timestamp Growing degree day (GDD)	xsd:string
Experiment description*	Text description of the unit of observation or assay (=		xsd:string

	genotype * factor combination) in a study.	1/ each maize line is observed on 15 rows with a density of 6 plant per square meters 2/ Observation on the assay are mean values of all repetition for a given genotype * factor combination	
Replication - Technical replication ID	IDentifier of each level of replication for a given assay	ex: block:1, plot:894, rep:1	xsd:string
Replication - technical replication level hierarchy	hierarchy of the different levels between each others (text: no ontology)	ex: block>rep>plot	xsd:string
Type of statistical design	Short description of the statistical design	ex: completely randomized design (CO_715:0000146)	xsd:string
Sample collection, processing, management			
ObservationUnitID*	Unique ID of the Observation Unit. The observation unit describes the object in an experiment on which the observation variable is measured. It is characterized by the biosource used, it is linked to experimental treatments and the environment description and it is one of the elements of the experimental design.		xsd:string
ObservationUnitType*	Text name of the type of observation unit.	ex: block, sub-lock, plot, plant, trial, sample, pot, replication or replicate, individual, virtual_trial, unit-parcel	xsd:string
BiosampleID	When the sample submitted to Biosamples DB this is the unique Biosample id	SAMEA4202911	xsd:string
Plant structure development stage	A stage in the life of a plant structure (PO:0009011) during which the plant structure undergoes developmental processes.	Fruit ripening stage	Plant Ontology:'PO_0009012'
Plant body	Plant anatomical entity		Plant Ontology:'PO_0025131'
Plant product	A portion of organism substance that is or was part of a plant	Resin	Plant Ontology:'PO_0025161'
Organism count	The number/(amount) of entities of this type that are part of the whole	10 roots; 100mg of roots	xsd:integer
Sample temperature	Temperature at Collection / Harvesting	20°C	xsd:float
Oxygenation status of sample	A setting datum that specifies the oxygenation inside a container participating in a storage process.	Vacuum	xsd:string

Sample salinity	A setting datum that specifies the salinity inside a container participating in a storage process.	20mM NaCl	xsd:string
Sample storage duration			xsd:string
Sample storage location	Top level of all location classes.	Campus, Building, Room	xsd:string
Sample storage temperature	A setting datum that specifies the temperature inside a container participating in a storage process.	-18 °C to -35 °C, -60 °C to -85 °C, Liquid nitrogen, Room temperature etc	xsd:string
Sampling time	The date-time when the sample was collected / harvested	2005-08-15T15:52:01+00:00	xsd:dateTime
Observed variables			
Trait	Name of the targeted trait or id in a relevant ontology	ex: Anthesis time (CO_322:0000030) or reproductive growth time (TO:0000366)	Plant Trait Ontology / Crop Ontology / XML Environment Ontology xsd:string
Variable name*	https://bioportal.bioontology.org/ontologies/CO (Trait_Dictionary_V5 definition): Name of the variable following the convention <trait abbreviation>_<method abbreviation>_<scale abbreviation>. Variable name must be unique.	ex: Growing Degree days to anthesis	Crop Ontology / xsd:string
Variable id	https://bioportal.bioontology.org/ontologies/CO	ex: CO_322:0000260	Crop Ontology / xsd:string
Source of the variable id	version of the ontology describing the variable	ex: Maize Trait Dictionary in template 5 - CIMMYT- December 2015	xsd:string
Variable Method*	https://bioportal.bioontology.org/ontologies/CO (Trait_Dictionary_V5 definition): (Short) name of the method	ex: MFLW8	xsd:string
Method description	https://bioportal.bioontology.org/ontologies/CO (Trait_Dictionary_V5 definition): Textual and generic description of the method. Optionaliy : extensaion of the Method of the Ontology with growth stage, inoculation precise organ (leave number)	ex: 1/ From Ritchie J, NeSmith D (1991) Temperature and crop development. Modeling plant and soil systems American Society of Agronomy Madison Wisconsin USA. doi:10.2134/agronmonogr31.c4 with TBASE=8°C and T0=30°C 2/ Extension of Method CO_321:0000456 (Plant Height measured with ruler) : Plant height	xsd:string

		measure at 5 years, one year after Botritis inoculation.	
Reference associated to the method	https://bioportal.bioontology.org/ontologies/CO (Trait_Dictionary_V5 definition): Bibliographical reference describing the method.	ex: Ritchie J, NeSmith D (1991) Temperature and crop development. Modeling plant and soil systems American Society of Agronomy Madison Wisconsin USA. doi:10.2134/agronmonogr31.c4	DOI / xsd:string
Scale*	https://bioportal.bioontology.org/ontologies/CO (Trait_Dictionary_V5 definition): Name of the scale associated to the variable	ex: GDD: Growing Degree-Days	xsd:string

¹Mandatory information when preparing a submission to BioSamples database (<http://www.ebi.ac.uk/biosamples>)

*Mandatory information