MIAPPE_Checklist_Data_Model

MIAPPE					
Minimum Information About a Plant Phenotyping Experiment					
MIAPPE Check list	**Codename**	**Definition**	**Example**	**Format**	**Cardinality**
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
Investigation unique ID	investigationId	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	investigationTitle	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 (ZCN8) Locus.	Free text (short)	1
Investigation description	investigationDescription	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 and diversity investigation on a panel of tropical and temperate American and European representatives.	Free text	0-1
Submission date	submissionDate	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
Public release date	publicReleaseDate	Date of first public release of the dataset presently being described.	2013-02-25	Date/Time (ISO 8601, optional time zone)	0-1
License	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 ; Unreported	Unique identifier	0-1
MIAPPE version	miappeVersion	The version of MIAPPE used.	1.1	Version number	1
Associated publication	associatedPublication	An identifier for a literature publication where the investigation is described. Use of DOIs is recommended.	doi:10.1371/journal.pone.0071377	DOI	0+
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

Study unique ID	studyId	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-fppn.fr/maugio/2013/t2351	Unique identifier	0-1
Study title	studyTitle	Name, human-readable text summarising the study	Maugio 2022	Free text (short)	1
Study description	studyDescription	Human-readable text describing the study	2002 evaluation of male and female flowering time for a panel of 375 maize lines representing the worldwide genetic diversity at the experimental station of Maugio, France.	Free text	0-1
Start date of study	studyStartDate	Date and, if relevant, time when the experiment started	2002-04-04 ; 2006-09-27T10:23:21+00:00	Date/Time (ISO 8601, optional time zone)	1
End date of study	studyEndDate	Date and, if relevant, time when the experiment ended	2002-11-27	Date/Time (ISO 8601, optional time zone)	0-1
Contact institution	contactInst	Name and address of the institution responsible for the study.	UMR de Génétique Végétale, INRA – Université Paris-Sud – CNRS, Gif-sur-Yvette, France	Free text (short)	1
Geographic location (country)	locationCountry	The country where the experiment took place, either as a full name or preferably as a 2-letter code.	FR	Country name or 2-letter code (ISO 3166)	1
Experimental site name	siteName	The name of the natural site, experimental field, greenhouse, phenotyping facility, etc. where the experiment took place.	INRA, UE Diascope - Chemin de Mezouls - Domaine expérimental de Melgueil - 34130 Mauguio – France	Free text (short)	1
Geographic location (latitude)	locationLatitude	Latitude of the experimental site in degrees, in decimal format.	43.619264	Degrees in the decimal format (ISO 6709)	0-1 (1 if longitude is provided)
Geographic location (longitude)	locationLongitude	Longitude of the experimental site in degrees, in decimal format.	3.967454	Degrees in the decimal format (ISO 6709)	0-1 (1 if latitude is provided)
Geographic location (altitude)	locationAltitude	Altitude of the experimental site, provided in metres (m).	100 m	Numeric + unit abbreviation	0-1
Description of the experimental design	expeDesignDesc	Short description of the experimental design, possibly including statistical design. In specific cases, e.g. legacy datasets or data computed from several studies, the experimental design can be "unknown"/"NA", "aggregated/reduced data", or simply "none".	Lines were repeated twice at each location using a complete block design. In order to limit competition effects, each block was organized into four sub-blocks corresponding to earliness groups based on a priori information.	Free text	1
Type of experimental design	expeDesignType	Type of experimental design of the study, in the form of an accession number from the Crop Ontology.	CO_715:0000145	Crop Ontology term (subclass of "CO_715:0000003" from https://agroportal.lirmm.fr/ontologies/CO_715)	0-1
Observation unit level hierarchy	obsUnitLevelHierarchy	Hierarchy of the different levels of repetitions between each others	block>rep>plot	Formatted text (level>level)	0-1
Observation unit description	obsUnitDesc	General description of the observation units in the study.	Observation units consisted in individual plots themselves consisting of a row of 15 plants at a density of approximately six plants per square meter. ; NA	Free text	1

Description of growth facility	growthFacilityDesc	Short description of the facility in which the study was carried out.	field environment condition ; NA	Free text (short)	1
Type of growth facility	growthFacilityType	Type of growth facility in which the study was carried out, in the form of an accession number from the Crop Ontology.	CO_715:0000162	Crop Ontology term (subclass of "CO_715:0000005" from https://agroportal.lirmm.fr/ontologies/CO_715)	0-1
Cultural practices	culturalPractice	General description of the cultural practices of the study.	Irrigation was applied according needs during summer to prevent water stress.	Free text	0-1
Map of experimental design	expeDesignMap	Representation of the experimental design.	https://urgi.versailles.inra.fr/files/ephesis/181000503/181000503_plan.xls	URL or File name (of gis or tabular file like csv or tsv)	0+
PERSON		A human involved in the investigation or specifically any of its studies.			1+ per investigation / 0+ per study
Person name	personName	The name of the person (either full name or as used in scientific publications)	Ines Chaves	Name	1
Person email	personEmail	The electronic mail address of the person.	ichaves@itqb.unl.pt	email address	0-1
Person ID	personId	An identifier for the data submitter. If that submitter is an individual, ORCID identifiers are recommended.	orcid.org/0000-0001-6494-0008 ; orcid.org/0000-0002-7054-800X	Unique identifier	0-1
Person role	personRole	Type of contribution of the person to the investigation	data submitter ; author ; corresponding author	Free text (short)	1+
Person affiliation	personAffiliation	The institution the person belongs to	ITQB, Portugal ; grid.10772.33	Free text (short)	1+
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
Data file link	dataFileLink	Link to the data file (or digital object) in a public database or in a persistent institutional repository; or identifier of the data file when submitted together with the MIAPPE submission.	https://www.ebi.ac.uk/arrayexpress/experiments/E-GEOD-32551/	URL or File name	1
Data file description	dataFileDesc	Description of the format of the data file. May be a standard file format name, or a description of organization of the data in a tabular file.	FASTA ; tab-delimited ; column headers headers: 1. A 2. B 3. C	Free text (short)	1
Data file version	dataFileVersion	The version of the dataset (the actual data).	1	Software version number	0-1
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
Biological material ID	biologicalMaterialId	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:rres_GK090847	Unique identifier	1
Biological material external ID	biologicalMaterialExtId	One to many identifiers for the biological material. Can include EBI Biosamples ID. URI are recommended when possible.	AGENT_project:AGENT_ID; Kernel_ID; experimentalPlateformID; GERMPLASM_DB_ID; Biosamples:SAMEA001234	Semicolon-separated list of unique identifiers, possibly prefixed by repository name	0+

Organism	organism	An identifier for the organism at the species level. Use of the NCBI taxon ID is recommended.	NCBITAXON:4577	Unique identifier	1
Genus	genus	Genus name for the organism under study, according to standard scientific nomenclature.	Zea ; Solanum	Genus name	0-1
Species	species	Species name (formally: specific epithet) for the organism under study, according to standard scientific nomenclature.	mays ; lycosperium x pennellii	Species name	0-1
Infraspecific name	infraspecificName	Name of any subtaxa level, including variety, crossing name, etc. It can be used to store any additional taxonomic identifier. To be filled as key-value pair list format (the key is the name of the rank/category and the value is the value of the rank/category). Ranks/categories 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). MIAPPE adds "cv." (cultivar).	subspecies:vinifera, cultivar:Pinot noir ; subsp.:aestivum, cv.:Weneda, Group:winter ; subsp. vinifera cv. Pinot Noir	Key-value pair list, or MCPD-compliant format	0-1
Biological material latitude	biologicalMaterialLatitude	Latitude of the studied biological material. [Alternative identifier for in situ material]	39.067	Degrees in the decimal format (ISO 6709)	0-1 (1 if longitude is provided)
Biological material longitude	biologicalMaterialLongitude	Longitude of the studied biological material. [Alternative identifier for in situ material]	-8.73	Degrees in the decimal format (ISO 6709)	0-1 (1 if latitude is provided)
Biological material altitude	biologicalMaterialAltitude	Altitude of the studied biological material, provided in meters (m). [Alternative identifier for in situ material]	10 m	Numeric + unit abbreviation	0-1
Biological material coordinates uncertainty	biologicalMaterialCoordUncertainty	Circular uncertainty of the coordinates, preferably provided in meters (m). [Alternative identifier for in situ material]	200 m	Numeric	0-1
Biological material preprocessing	biologicalMaterialPreprocessing	Description of any process or treatment applied uniformly to the biological material, prior to the study itself. Can be provided as free text or as an accession number from a suitable controlled vocabulary.	EO:0007210 – PVY(NTN) ; transplanted from study http://phenome-fppn.fr/maugio/2013/t2351 ; observation unit ID: pot:894	Plant Environment Ontology and/or free text	0+
Material source ID (Holding institute/stock centre, accession)	materialSourceId	An identifier for the source of the biological material, in the form of a key-value pair comprising the name/identifier of the repository from which the material was sourced plus the accession number of the repository for that material. Where an accession number has not been assigned, but the material has been derived from the crossing of known accessions, the material can be defined as follows: "mother_accession X father_accession", or, if father is unknown, as "mother_accession X UNKNOWN". For in situ material, the region of provenance may be used when an accession is not available. The Material source is commonly called germplasm, accession, genotype and even variety for commercial varieties. For the	INRA:W95115_inra ; ICNF:PNB-RPI	Unique identifier	0-1

		latest, keep in mind that a variety is commonly ambiguously identified and polysemous			
Material source DOI	materialSourceDoi	Digital Object Identifier (DOI) of the material source	doi:10.15454/1.4658436467893904E12	DOI	0-1
Material source accession number	materialSourceAccNumber	Unique identifier for accessions within a genebank. If material source is not from a genebank, use a laboratory ID. In the case of a commercial variety, use the variety code, or name if no code available.	W95115_inra; SYNTHETICS R93; APACHE	Unique identifier	0-1
Material source accession name	materialSourceAccName	Can be: (i)genebank accession registered name or other designation given to the material, other than the donor"s accession number or collecting number. (ii) Variety name.	Rheinische Vorgebirgstrauben	Free text (short)	0-1
Material source institute code	materialSourceInstCode	FAO WIEWS code of the institute where the accession is maintained. The current set of institute codes is available from https:// www.fao.org/wiews. If no institute code is available, create your own (Laboratory acronym or research institute acronym ...).	FRA09	Unique identifier	0-1
Material source institute name	materialSourceInstName	Name of the material source institute.	INRA	Institute name	0-1
Material source other identifiers	materialSourceOtherIds	Any other identifiers known to exist in other collections for this material source. Use key:value pairs, separated by semicolons.	AGENT_ID:AB_06024; Yet_Another_ID:YAID_123	Key:Value pairs	0-1
Material source latitude	materialSourceLatitude	Latitude of the material source. [Alternative identifier for in situ material]	39.067	Degrees in the decimal format (ISO 6709)	0-1 (1 if longitude is provided)
Material source longitude	materialSourceLongitude	Longitude of the material source. [Alternative identifier for in situ material]	-8.73	Degrees in the decimal format (ISO 6709)	0-1 (1 if latitude is provided)
Material source altitude	materialSourceAltitude	Altitude of the material source, provided in metres (m). [Alternative identifier for in situ material]	10 m	Numeric + unit abbreviation	0-1
Material source coordinates uncertainty	materialSourceCoordUncertainty	Circular uncertainty of the coordinates, provided in meters (m). [Alternative identifier for in situ material]	200 m	Numeric + unit abbreviation	0-1
Material source description	materialSourceDesc	Description of the material source	Branches were collected from a 10-year-old tree growing in a progeny trial established in a loamy brown earth soil.	Free text	0-1
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
Environment parameter	envParam	Name of the environment parameter constant within the experiment.	sowing density; rooting medium composition; pH	Free text (see Appendix I)	1+
Environment parameter value	envParamValue	Value of the environment parameter (defined above) constant within the experiment.	300 seeds per m2; Clay 50% plus sand; 6.5	Free text	1 per parameter
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

Experimental Factor type	expeFactorType	Name/Acronym of the experimental factor.	Watering	Free text (see Appendix II)	1
Experimental Factor description	expeFactorDesc	Free text description of the experimental factor. This includes all relevant treatments planification and protocol planned for all the plants targeted by a given experimental factor.	Daily watering 1 L per plant.	Free text	0-1
Experimental Factor values	expeFactorValues	List of possible values for the factor.	Watered; Unwatered	Free text	2+ per factor
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
Event type	eventType	Short name of the event.	Planting; Fertilizing	Free text (short)	1
Event accession number	eventAccNumber	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 from https://agroportal.lirmm.fr/ontologies/CO_715)	0-1
Event description	eventDesc	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
Event date	eventDate	Date and time of the event.	2006-09-27T10:23:21+00:00 ; 2006-10-27, 2006-11-13, 2016-11-21	Date/Time (ISO 8601, optional time zone)	1+
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
Observation unit ID	obsUnitId	Identifier 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
Observation unit type	obsUnitType	Type of observation unit in textual form, usually one of the following: study, block, sub-block, plot, sub-plot, pot, plant. Use of other observation unit types is possible but not recommended. The observation unit type cannot be used to indicate sub-plant levels. However, observations can still be made on the sub-plant level, as long as the details are indicated in the associated observed variable (see observed variables). Alternatively, it is possible to use samples for more detailed tracing of sub-plant units, attaching the observations to them instead.	plot	Free text	1
Observation unit external ID	externalId	Identifier for the observation unit in a persistent repository, comprises the name of the repository and the identifier of the observation unit therein. The EBI Biosamples repository can be used. URI are recommended when possible.	Biosamples:SAMEA4202911	Unique identifier	0+
Spatial distribution	spatialDistribution	Type and value of a spatial coordinate (georeference or relative) or level of observation (plot 45, subblock 7, block 2) provided as a key-value pair of the form type:value. Levels of observation must be consistent with those listed in the Study section.	latitude:+2.341, row:4, X:3, Y:6, Xm:35, Ym:65; block:1; plot:894	Formatted text (Key:value)	0+

Observation Unit factor value	obsUnitFactorValue	List of values for each factor applied to the observation unit.	Watered	Free text	0+
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
Sample ID	sampleId	Unique identifier for the sample.	CEA:BE00034067	Unique identifier	1
Plant structure development stage	developmentStage	The stage in the life of a plant structure during which the sample was taken, in the form of an accession number to a suitable controlled vocabulary (Plant Ontology, BBCH scale)	PO:0025094; BBCH-17	Plant Ontology term (subclass or PO:0009012) or BBCH scale term	0-1
Plant anatomical entity	anatomicalEntity	A description of the plant part (e.g. leaf) or the plant product (e.g. resin) from which the sample was taken, in the form of an accession number to a suitable controlled vocabulary (Plant Ontology).	PO:0000003 ; PO:0025161	Plant Ontology term (subclass of PO:0025131)	1
Sample description	sampleDesc	Any information not captured by the other sample fields, including quantification, sample treatments and processing.	Distal part of the leaf ; 100 mg of roots taken from 10 roots at 20°C, conserved in vacuum at 20 mM NaCl salinity, stored at -60 °C to -85 °C.	Free text	0-1
Collection date	collectionDate	The date and time when the sample was collected / harvested	2005-08-15T15:52:01+00:00	Date/Time	1
Sample external ID	externalId	An identifier for the sample in a persistent repository, comprising the name of the repository and the accession number of the observation unit therein. Submission to the EBI Biosamples repository is recommended. URI are recommended when possible.	Biosamples:SAMEA4202911	Unique identifier	0+
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
Variable ID	variableId	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
Variable name	variableName	Name of the variable.	Anthesis computed in growing degree days	Free text	0-1
Variable accession number	variableAccNumber	Accession number of the variable in the Crop Ontology	CO_322:0000794	Crop Ontology term	0-1
Trait	traitName	Name of the (plant or environmental) trait under observation	Anthesis time; Reproductive growth time	Free text	1
Trait Entity	traitEntity	Entity (part of the plant, whole plant, group of plant e.g. canopy) on which the trait has been measured	Leaf	Free text	0-1
Trait Entity Accession number	traitEntityAccessionNumber	Accession number of the trait entity in a suitable controlled vocabulary (Plant Ontology).	http://purl.obolibrary.org/obo/PO_0025034	Term from Plant Trait Ontology, Crop Ontology, or XML Environment Ontology	0-1

Trait Characteristic	traitCharacteristic	Characteristic measured. It can be a morphological characteristic (size, volume, surface), a molecular characteristic (sugar concentration), etc...	Area	Free text	0-1
Trait Characteristic Accession number	traitCharacteristicAccessionNumber	Accession number of the trait characteristic in a suitable controlled vocabulary (PATO - the Phenotype And Trait Ontology).	http://purl.obolibrary.org/obo/PATO_0001323	Term from Plant Trait Ontology, Crop Ontology, or XML Environment Ontology	0-1
Trait accession number	traitAccNumber	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
Method	methodName	Name of the method of observation	Growing degree days to anthesis	Free text	1
Method accession number	methodAccNumber	Accession number of the method in a suitable controlled vocabulary (Crop Ontology, Trait Ontology).	CO_322:0000189	Term from Plant Trait Ontology, Crop Ontology, or XML Environment Ontology	0-1
Method description	methodDesc	Textual description of the method, which may extend a method defined in an external reference with specific parameters, e.g. growth stage, inoculation precise organ (leaf number)	Days to anthesis for male flowering was measured in thermal time (GDD: growing degree-days) according to Ritchie J, NeSmith D (1991;Temperature and crop development. Modeling plant and soil systems American Society of Agronomy Madison, Wisconsin USA) with TBASE=8°C and T0=30°C. ; Plant height was measured at 5 years with a ruler, one year after Botritis inoculation.	Free text	0-1
Reference associated to the method	methodRef	URI/DOI of reference describing the method.	https://doi.org/10.2134/agronmonogr31.c2	URI or DOI	0-1
Scale	scaleName	Name of the scale associated with the variable	°C day	Unique identifier	1
Scale accession number	scaleAccNumber	Accession number of the scale in a suitable controlled vocabulary (Crop Ontology).	CO_322:0000510	Crop Ontology term	0-1
Time scale	timeScale	Name of the scale or unit of time with which observations of this type were recorded in the data file (for time series studies).	Growing degree day (GDD); Date/Time	Free text	0+

MIAPPE_Appendix_Environment

Environment			
Non-exhaustive list of Environment Parameters.			
Environment parameters	**Definition**	**Example environment parameter values**	**Format**
Growth facility			
Air temperature	List of hourly air temperature throughout the experiment.	22 °C	Numeric
Organ temperature	List of hourly organ temperatures throughout the experiment	18 °C	Numeric
Change over the course of experiment	Difference between the maximum air temperature recorded and the minimum.	0.75 °C	Numeric
Photon flux density (PPFD) measured at plant or canopy level	List of hourly Photosynthetic photon flux density (PPFD) throughout the experiment.	PPFD: 89061 mol m-2 sd-1;	Text
Average length of the light period	Average length of the light period in h.	16	Numeric
Light intensity	Intensity of total light	[_mol m-2 s-1]	Numeric
Range in peak light intensity	Range in peak light intensity for the whole experiment.	[_mol m-2 s-1]	Numeric
Fraction of outside light intercepted by growth facility components and surrounding structures	Fraction of outside light intercepted by growth facility components and surrounding structures.	Number between 0 and 1	Numeric
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)	Text
R/FR ratio	Red light to far red light ratio. XEO:00036	[mol mol-1]	Numeric
Daily UV-A radiation	Intensity of UVA radiation (320-400 nm); XEO:00037	[W m-2]	Numeric
Daily UV-B radiation	Intensity of UVB radiation (290-320 nm); XEO:00038	[W m-2]	Numeric
Total daily irradiance	Intensity of total light (XEO:00034) averaged over the experiment.	[W m-2]	Numeric
Atmospheric CO2 concentration	Denotes whether the atmospheric CO2 concentrations were controlled during the experiment.	controlled; uncontrolled	Numeric
Average CO2 during the light and dark periods	Concentration of CO2 in the air during the light and dark periods (XEO: 00023)	light period: 390 mLL-1; dark period: 450 mLL-1	Text
Vapour pressure deficit	Vector of hourly VPD throughout the experiment .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	Numeric
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%	Numeric
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 light period in kPa (XEO:00021)	2.7 kPa	Numeric

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%	Numeric
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	Type of container used to grow/treat the plants.XEO:00040	pot; Petri dish; well; tray	Text
Container volume	Volume that is available to the roots. XEO:00113	[L]	Numeric
Container height	Height of the container.	[m]	Numeric
Number of plants per containers	Number of plants per container. XEO:00112	X/container	Numeric
Plot size	Description of experimental sites.	higher-level landform; land element and position; slope;	Crop Ontology:'CO_715:0000058'
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.		Text
pH	Value of soil pH, separated by a colon, the depth (cm) from where soil sample was taken. Multiple values are separated by semicolon.	7.7:40-60; 6.5; 4.3:10-20	Text
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	[%]	Numeric
Medium temperature	Temperature of the replenishment medium.	[°C]	Numeric
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]	Numeric
Water retention capacity	Potential energy of water per unit mass of water in the soil.XEO:00126	[g g-1 dry weight]	Numeric
Organic matter content	Proportion of organic matter in the soil. XEO:00117	[%]	Numeric
Nutrients			
Medium composition	Concentration of the nutrients	Ca (XEO:00058): 5 mg/L	XEML Environment Ontology:'XEO_00042' + Numeric
Extractable N content per unit ground volume before fertiliser added	Extractable N content per unit ground area before fertiliser added	[mg/m2]	XEML Environment Ontology:'XEO_00054' +Numeric
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' + Numeric
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' + Numeric
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/m2]	XEML Environment Ontology:'XEO_00054' +Numeric
Volume and timing of water added per container	A defined volume of water supplied to each pot.	[L]	Numeric

Matrix potential	Range in water potential for soil.	-10 to -30 kPa	Numeric
Watering regimen	The treatment involving an exposure to watering frequencies.	irrigation from top; irrigation from bottom; drip irrigation	Text
Composition of nutrient solutions used for irrigation	For all nutrients, including micronutrients, the ontology term with concentration.	Ca (XEO:00058): 5 mg/L	XEML Environment Ontology:'XEO_00042' + Numeric
Electrical conductivity	A conductivity quality inhering in a bearer by virtue of the bearer's ability to convey electricity.	[dS m-1]	Numeric

MIAPPE_Appendix_Experimental_Factors

Experimental Factors			
Non-exhaustive list of Experimental Factors.			
Factor type	**Definition**	**Example factor values**	**Format**
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'
Plant 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' / Text
Chemical regime	A chemical treatment (EO:0007189) involving the application of inorganic chemicals, nutriment, organic chemicals, etc. as supplement to study various types of responses	Cd 0.5 mg/L (Hydroponics), CdCl2 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'
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.	NaCl:150mM ; KCl:30mM	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.	Glyphosfate; 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			Text