



DIVERSify: Designing InnoVative plant teams for Ecosystem Resilience and agricultural Sustainability

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Work Package 5: Plant trait and agronomic Open Data e-infrastructure, data visualisation and Decision Aid

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Executive Summary

The Decision Aid in WP 5 will be based on data produced in DIVERSify and existing data from partners in the project as well as data from outside the project. This deliverable report describes the setup of the dataset behind the Decision Aid. To gather and align existing data, information on relevant species were collected from all partners. Based on the knowledge of species, information on sowing time (autumn/spring) and harvest (combine harvest/biomass) a template was created to gather the existing data. To create a template that covers a wide range of relevant parameters, datasets from L&F SEGES and James Hutton Institute were reviewed regarding metadata, treatments and registrations. The draft of the template was tested and commented by ESA. The metadata part of the template was coordinated with WP4 Task 4.4 in which the preexisting data from Core Partner Platforms are collected and new data from Core Partner Platforms and participatory farmers will be created. Literature studies have identified relevant data outside the consortium, and contact will be made to include these data in the dataset if possible.





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1. Introduction

Monoculture is the most widespread growing method and well known to farmers. Introducing mixed species crops (or ‘plant teams’) must be based on evidence of the advantages of this growing system. The advantages will be different for a conventional farmer, a low input farmer or an organic farmer. DIVERSify will include them all based on their starting point. Existing knowledge on mixed species cropping is available and the advantages and disadvantages are well described and will be implemented in Work Package 5. A Decision Aid, that enables farmers and advisors to include data and knowledge from all over Europe in their discussion and inspiration on using plant teams, is an aim of Work Package 5. The purpose of this deliverable report is to describe the setup of the dataset behind the Decision Aid. The overall aim is to include as many relevant data as possible. This leads to a detailed registration on farming type, data origin and type of data. In the dataset, information will be included on entry level, with information on replicates and statistical values. Existing data will be mostly from trials. Work Package 4 will produce important information from trials within the project consortium and also from Participatory Farmers. Work Package 1 will sample tacit knowledge from farmers. Work Package 2 will produce new data from scientific plot-scale trials. These data will be included in the Decision Aid. Working on a European scale raises the issue of different growing conditions. Information on climatic conditions is crucial, together with the local main challenges to which plant teams could be a solution. Inspiration from other countries must be based on a well-documented description of the growing conditions, and a guideline to which extent this is relevant in any given country. The work in Work Package 5 is closely related to Work Package 1 (tacit knowledge), Work Package 2 (new scientific data), Work Package 4 (Core Partner data and Participatory Farmer data).

2. Agronomic review of methods used in existing datasets

2.1. Data types

The method “data types” is defined by the type of existing data that should be collected in Work Package 5. In Task 5.1, these data are being evaluated and chosen. The data types contain metadata and data on registrations. Metadata collected in Task 5.1 is at trial level and data is at treatment/entry level and existing statistical analyses are used. This decision is taken in consultation with the project leader based on existing data that we already know of and to simplify the data which feeds into the decision aid.

The metadata contains information on: trial identification (ID), ownership and use of data, data description, trial location, climate, type of trial, farming system, soil properties, basic treatments, number of replicates, statistics and an overall evaluation of the trial.





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The treatment and registrations contain information on: trial ID, treatment ID, species information, sowing, and registrations after emergence, after weeding and after winter. It also includes crop description in the growing season, information on weeds, diseases and pests, harvest information, combined yield of mixtures, biomass yield and quality (see Table 1).

The specific items in the different categories in the data template have been validated by Joëlle Fustec and Guénaëlle Corre-Hellou representing WP5 beneficiary partner ESA. They have commented and given input based on knowledge of their own existing plant team data.

The final template has been sent to other beneficiary partners the 1st March 2018 for revision and validation and, at the time of deliverable submission, has been commented on by Jen Benfield-Zanin (STC).

Table 1

Metadata	
Category and purpose	Examples of specific items
ID Indicators to facilitate accurate data management	<ul style="list-style-type: none"> • ID Trial – subjective indicator for reference and identification • Year of trial (harvested) • Growing season (spring/winter)
OWNERSHIP AND USE OF DATA Queries to allow for an appropriate Creative Common License to be applied to project outputs eventually using any submitted data.	<ul style="list-style-type: none"> • Data owner (institute) • Citation text • Contact person • Queries on attribution, adaptation, and use of permission (including for data aggregation)
DATA DESCRIPTION Nature of trial in which data was collected.	<ul style="list-style-type: none"> • Origin (for this deliverable data is ‘external data’ or ‘existing data from partners’) • Type of data (e.g. Scientific, On-farm trial, demonstration)
TRIAL LOCATION To enable accurate geographic referencing in further data analyses and use.	<ul style="list-style-type: none"> • EU region (Atlantic, Continental, Alpine, Mediterranean). • Country and national region • GPS coordinates – longitude and latitude
CLIMATE (YEAR OF TRIAL) General, broad outline of climatic variables to enable further data analysis and use.	<ul style="list-style-type: none"> • Total annual precipitation • Annual mean, minimum and maximum temperature





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<p>TYPE OF TRIAL</p> <p>To add context to trial purpose and available data therein.</p>	<ul style="list-style-type: none"> • Description of overall and specific purpose of the trial
<p>FARMING SYSTEM</p> <p>Indicators of farming and agronomic practice.</p>	<ul style="list-style-type: none"> • Experiment type – indication of scale of experiment (e.g. Field, Glasshouse or laboratory). • Type of production – conventional, organic or integrated. • Farm type – Arable, Livestock, Experimental. • Previous crop in trial • Use and quantity of irrigation • Use and type of conservation tillage, if utilized.
<p>SOIL PROPERTIES</p> <p>To provide pedoclimatic indicators.</p>	<ul style="list-style-type: none"> • Soil type and subtype • Soil contents of clay, sand, gravel, silt, humus and organic carbon. • Soil Nitrogen (N-min) and date of N-min sampling • Soil Phosphorous and Potassium • Soil temperature at sowing
<p>BASIC TREATMENTS</p> <p>To provide agronomic context to trials.</p>	<ul style="list-style-type: none"> • Soil cultivation utilized before sowing • Mechanical weeding used • Types, application rates, and time of application of any fertilizer and pesticide inputs.
<p>STATISTICS</p> <p>To ensure statistical comparability across trials and to validate each trial.</p>	<ul style="list-style-type: none"> • Number of replicates in trial • Identification of factors in a multi factorial trial. • LSD and P-value (yield) for each species in the mixture. For each factor 1, 2, 3 or more and interactions between factors 12, 13, 23 and 123.
<p>Other</p>	<ul style="list-style-type: none"> • Relevant information on trial level, not included in the previous information.
<p>Evaluation of the trials</p>	<ul style="list-style-type: none"> • Overall evaluation of the trial and all information on trial conditions relevant to the use of the data, e.g. late sowing, bad sowing conditions, insufficient treatments, other hazards to the trial, harvest problems.
Treatments and registrations	
<p>ID</p> <p>Indicators to facilitate accurate data management</p>	<ul style="list-style-type: none"> • ID Trial and treatment/entry – subjective indicator for reference and identification





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<p>SPECIES INFORMATION</p> <p>Specifications on plant species tested as part of trial.</p>	<ul style="list-style-type: none"> • Latin name and variety name for species in mixture • Percentage of seed rate relative to pure stand
<p>SOWING</p> <p>To provide agronomic context to trials.</p>	<ul style="list-style-type: none"> • Sowing date, depth and density (seeds/m²) • Information on row formation and distance • Date of emergence
<p>AFTER EMERGENCE</p> <p>To provide agronomic context to trials.</p>	<ul style="list-style-type: none"> • Number of plants of all species in mixture at emergence followed by BBCH growth stage
<p>AFTER WEEDING</p> <p>To provide agronomic context to trials.</p>	<ul style="list-style-type: none"> • Number of plants of all species in mixture after weeding followed by BBCH growth stage
<p>AFTER WINTER</p> <p>To provide agronomic context to trials.</p>	<ul style="list-style-type: none"> • Number of plants after winter followed by BBCH growth stage
<p>GROWING SEASON, CROP DESCRIPTION</p> <p>To provide agronomic context to trials.</p>	<ul style="list-style-type: none"> • General ground cover of mixture • Plant height, number of tillers, lodging/crop height for each species • Vegetative biomass and Leaf area index <p>Every registration followed by BBCH growth scale</p>
<p>WEEDS</p> <p>To provide information of physical impact on the crop.</p>	<ul style="list-style-type: none"> • Visual total, monocot and dicot weed cover (% cover) • Total number, monocot and dicot number of weeds • Total, monocot and dicot weed cover in DM <p>Every registration followed by BBCH growth scale</p>
<p>DISEASES</p> <p>To provide agronomic context to trials.</p>	<ul style="list-style-type: none"> • Latin and English name of disease • Species in the mixture affected, part of plant covered and pct. cover followed by BBCH growth scale
<p>PESTS</p> <p>To provide agronomic context to trials.</p>	<ul style="list-style-type: none"> • Latin and English name of disease • Species in the mixture affected, the part of plant covered (heads, pods, stem, etc.) and %cover of the specific part followed by BBCH growth scale
<p>HARVEST</p> <p>To provide agronomic context</p>	<ul style="list-style-type: none"> • Date of maturity and harvest





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to trials.	
COMBINE YIELD To provide agronomic context to trials.	<ul style="list-style-type: none"> Water content, grain/seed yield, seed weight, hectoliter weight, starch in dry matter, crude protein in dry matter and Nitrogen in dry matter for both single species and mixture.
BIOMASS YIELD To ensure quality parameters of biomass.	<ul style="list-style-type: none"> Biomass yield for mixture and single species in mixture followed by BBCH growth scale.
QUALITY (BIOMASS HARVEST) To ensure quality parameters of biomass.	<ul style="list-style-type: none"> Dry matter content, crude ash in dry matter, crude protein in dry matter, sugar in dry matter, NDF, AHEE, NCGD, DOMD and Energy ME¹.
OTHER	Here additional data that is not predetermined in the template can be added.

¹NDF (Neutral Detergent Fiber) % in Dry Matter, AHEE (Acid Hydrolysis Ether Extract) %, NCGD (Neutral Cellulase/Gammanase Digestibility) %, DOMD (Digestible Organic Matter in Dry Matter) %, Energy ME (MJ/Kg Dry Matter).

2.2. Formats

The data formats used in this task will be Excel and csv files, as this is the most efficient format to collect large datasets from several partners and will allow ubiquity of use by all partners and external dataset providers. The decision of the most appropriate dataset formats has been agreed in collaboration with Panagiotis Zervas, representing WP5 partner AgroKnow.

2.3. Sources/databases

Sources and databases used to gain knowledge about pre-existing datasets for this task are listed below:

- Partners from the project have provided knowledge of existing species data in the Consortium. An email was sent out to all partners in the Consortium, with the request to respond on whether they had suitable datasets or not. 14 partners did return information and 10 of these partners had species mixture datasets to contribute. The list is divided into biomass production (winter or spring sown) and grain maturity (winter or spring sown). See Appendix 1 for the full list of relevant partners.
- L&F SEGES owns a major part of the pre-existing datasets in this task. 157 trials conducted since 1992 (organic and conventional) represents a substantial source of data that can be used as starting point for the data collection for the decision aid. Data from the trials have been extracted from the Nordic Field Trials System (NFTS) into excel format. See Appendix 2 for the full list of datasets.





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- A literature study has been conducted to align the template with existing methods and standards and to search for relevant datasets outside the project. To search literature, Web of Science and Organic Eprint have been searched using the keywords 'intercropping', 'agriculture', 'Europe'. A list of the literature identified using this approach is shown in Appendix 3
- Metadata collected in WP4. At the Core Partner platforms used in WP4 for field-scale validation of plant teams, there are pre-existing data available. These historic datasets have been provided by the James Hutton Institute (JHI), Universita Politecnica delle Marche (UNIVPM), Stockbridge Technology center (STC), Agencia Estatal Consejo Superior de Investigaciones Cientificas (CSIC) and L&F SEGES. L&F SEGES is not a typical Core Partner platform as it uses commercial fields for field validation rather than existing long-term experimental farm platforms, and therefore there is currently no historic information or metadata available. However, the location of field trials for L&F SEGES will be decided and performed in spring 2018, when the metadata will become available. See Appendix 4.

2.4. Knowledge organisation schemes and relevant standards

To ensure certain standards are met for data and meta-data collation and to facilitate flow of knowledge into WP5, some relevant standards have been followed while developing the pre-existing data template. The standards form the basis for the parameters selected in the pre-existing data template, and are listed below.

- **BBCH growth scale:**
At each measurement, the actual growth stage should be noted. Use species specific BBCH scales e.g. cereals, peas and beans.
- **Guide for soil samples:**
International ISO standards for soil samples.
- **Guideline for Nordic Field Trial System:**
"Kvalitet i Landsforsøgene". A unique Danish quality system for securing and documenting experiments in the field. The system includes instructions for the most important activities in the fields and standards for facilitation, spraying, fertilizing, registrations, harvest, samples and calculations.
<https://www.landbrugsinfo.dk/planteavl/landsforsoeg-og-resultater/kvalitet-i-landsforsoegene/sider/startside.aspx>
For example, of According to protocol for Assessments of National Field Trials see **Appendix 2**.
- **Standard for soil types and subtypes:**
FAO soil units used as standard.





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- **Protocol for trait assessment in plant teams:**
Developed in Work Package 2.
- **Standards protocols for data collection by Core Partners:**
Developed in Work Package 4.
- **Glossary:**
A first draft of a glossary to be used for aligning terminology in the project has been devised in Work Package 5. The glossary will subsequently be circulated to WP2, WP3 and WP4 in that order to be completed with all relevant data. The glossary will set the standard for dataset terminology.

2.5. Specifications and protocols for plant trait and agronomic data collection

- **Data capture form.**
A data capture form for existing data has been prepared. The metadata part of the capture form was prepared in collaboration with WP4 to align data collection for the project e-Data infrastructure. The form was constructed in Microsoft Excel, for ease and ubiquity of use by all core partners. The overall structure of the form is identification metadata, treatment data, method of description, registration time, method used (see Appendix 5).
- **Guideline for completion.**
The guideline for completion of the meta-data and data templates is a document describing how to complete the Excel data capture form. Every item in the form is described in the guide to avoid misunderstandings (see Appendix 6).

3. Outlook and data storage

The datasheet for collation of pre-existing data will be sent to all partners in the project, and the returned datasets will be kept separately for each partner. Data from outside the project will be collected by L&F SEGES and kept in the same way. Separate datasets enable handling of the data in the Decision Aid with clear references and different levels of confidentiality.

Data produced in Work Packages 2, 3 and 4 will be collected through the project and data on plot level will be kept in datasets for these Work Packages. The data will be included in the Work Package 5 dataset on entry level and will be used for the open data publication e-infrastructure (D5.2) and Decision Aid (D5.4).

Submitted files will be stored locally on a secure and backed-up server during the process of processing and validation. Original submitted files will be stored as well as the validated datafiles. To ensure data quality, internal guidelines laid out in the project will be followed (Karley, 2017). The





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validated datasets will be uploaded onto the project SharePoint in due course, and long-term storage will comply with DIVERSify's data management plan (Zervas, 2018).

References

Zervas P. (2018). D6.4 – Final Data Management Plan. Developed by the EU-H2020 project DIVERSify ('Designing innovative plant teams for ecosystem resilience and agricultural sustainability'), funded by the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement Number 727824.

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Nordic Field Trials System. Version 1.1.6638.27396. Teknologisk institute and SEGES.

Rubæk G. H. and Sørensen P (RED.) (2011) Jordanalyser – kvalitet og anvendelse. DCA rapport nr. 002 December 2011.

Disclaimer

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Appendices

- I. Appendix 1 – Existing species mixtures data from partners
- II. Appendix 2 – Existing datasets of L & F SEGES
- III. Appendix 3 – Overview of literature
- IV. Appendix 4 – Overview of metadata from Core Platforms
- V. Appendix 5 – Data capture form
- VI. Appendix 6 – Guideline for completion





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Appendix 1 - Existing species mixtures data from partners

Organization	Winter sown Biomass harvest	Spring sown Biomass harvest	Winter sown Combine harvest	Spring sown Combine harvest
SLU	White clover - winter wheat White clover - oil seed rape	Faba bean - wheat Lupine - wheat Lupine - spring barley Lupine - barley - oat	White clover - winter wheat White clover - oil seed rape	White clover - winter wheat White clover - oil seed rape Faba bean - wheat Field pea - wheat Field pea - oat
JHI	Barley - wheat Barley - triticale Barley - pea Barley - bean Wheat - oat Wheat - triticale Wheat - pea Wheat - bean Oat - triticale Oat - bean Triticale - rye Triticale - bean Triticale - pea Rye - bean Barley - wheat - pea Barley - triticale - pea Wheat - triticale - pea	Wheat - faba bean	Wheat - faba bean	Barley - field pea





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	<p>Oat - triticale - pea Triticale- rye - pea Barley - oat - bean Barley - rye - bean Barley - wheat - bean Barley -triticale - bean Wheat - oat - bean Wheat - rye - bean Wheat - triticale -bean Oat - rye - bean Oat - triticale - bean Triticale - rye - bean Wheat - barley - oat - pea Wheat - barley - oat - bean Triticale - barley - oat - pea Triticale - barley - oat - bean Rye - barley - oat - pea Rye - barley - oat - bean Wheat - barley - oat - rye - triticale - pea Wheat - barley - oat - rye - triticale - bean Rye - oat - IRG Rye - barley - IRG Rye - triticale - IRG Oat - barley - IRG Oat - triticale - IRG Barley - triticale -IRG Rye - oat - IRG</p>			
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Rye - triticale - IRG			
Oat - barley - IRG			
Oat - triticale - IRG			
Barley - triticale -IRG			
Rye - triticale - vetch			
Oat - barley - vetch			
Oat - triticale - vetch			
Barley - triticale -vetch			
Rye - oat - vetch			
Rye - triticale - vetch			
Oat - barley - vetch			
Oat - triticale - vetch			
Barley - triticale -vetch			
Rye - triticale - pea			
Oat - barley - pea			
Oat - triticale - pea			
Barley - triticale -pea			
Rye - oat - pea			
Rye - triticale - pea			
Oat - barley - pea			
Oat - triticale - pea			
Barley - triticale -pea			
Rye - oat - bean			
Rye - barley - bean			
Rye - triticale - bean			
Oat - barley - bean			
Oat - triticale - bean			





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Barley - triticale - bean			
Rye - oat - bean			
Rye - triticale - bean			
Oat - barley - bean			
Oat - triticale - bean			
Barley - triticale - bean			
Rye - oat - clover			
Rye - barley - clover			
Rye - triticale - clover			
Oat - barley - clover			
Oat - triticale - clover			
Barley - triticale - clover			
Rye - oat - clover			
Rye - triticale - clover			
Oat - barley - clover			
Oat - triticale - clover			
Barley - triticale - clover			
Rye - oat			
Rye - wheat			
Rye - barley			
Rye - IRG			
Rye - pea			
Rye - vetch			
Oat - wheat			
Oat - barley			
Oat - IRG			
Oat - pea			





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	<p>Oat - vetch Rye - oat - pea Rye - wheat - pea Rye - barley - pea Rye - IRG - pea Rye - oat - vetch Rye - wheat - vetch Rye - barley - vetch Rye - IRG - vetch</p>			
ESA	Wheat - field pea	Barley - field pea	<p>Wheat - field pea Triticale - lupine Wheat - lupine</p>	Barley - field pea
STC	Wheat - clover	Barley - clover	Wheat - clover	Barley - clover
SzG				<p>Phaseolus coccineus - maize Phaseolus vulgaris - maize Faba bean - wheat Phaseolus coccineus - sorghum Phaseolus vulgaris - sorghum Faba bean - oat Faba bean - lathyrus sativus</p>
WWU		<p>Wheat - faba bean Barley - field pea</p>		
ORC		Wheat - faba bean		Wheat - faba bean





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KEFRI		Maize - field bean		Maize - field bean
SEGES		Barley - field pea Wheat - lupine Wheat - soybean Wheat - soybean Field pea - quinoa - barley Field pea - lupine Field pea - IRG Barley - IRG Seed flax - IRG Field pea - Ryegrass Field pea - grass	Wheat - lupine Wheat - field pea Wheat - faba bean	Wheat - lupine Wheat - field pea Triticale - fabe bean Lupine - faba bean Barley - lupine Lupine - field pea Barley - field pea Barley - oat Wheat - oat Barley - triticale Barley - triticale- wheat - oat Lupine - triticale Lupine - barley Oat - field pea Maize - soybean Maize - faba bean Maize - runner bean Maize - stangbønne Field pea - faba bean Barley - lupine - field pea Barley - faba bean Wheat - fodder vetch





Appendix 2 – Existing datasets of L & F SEGES

ID	Year	Number of trials	Crops	Name of trial	Production
020061515-001	2015	3	Lupine, spring wheat	Lupin - varieties and sowing time	Organic
020061515-002					
020061515-003					
020061414-001	2014	5	Lupine, spring wheat	Lupin - varieties and sowing time	Organic
020061414-002					
020061414-003					
020061414-004					
020061414-005					
020061313-001	2013	4	Lupine, spring wheat	Lupin - varieties and sowing time	Organic
020061313-002					
020061313-003					
020061313-005					
020171313-001	2013	2	Lupine, spring wheat	Stable yield in lupine spring wheat mixtures	Organic
020171313-002					
020171313-003					
020171212-001	2012	2	Lupine, spring wheat	Stable yield in lupine spring wheat mixtures	Organic
020171212-002					
020041111-001	2011	5	Field pea, spring wheat	Pea production with good weed competition	Organic
020041111-002					





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020041111-003					
020041111-004					
020041111-005					
020071111-001	2011	3	Faba bean - spring triticale	Robust production of grain legumes	Organic
020071111-002			Faba bean - lupine		
020071111-003			Lupine - spring triticale		
			Lupine - spring barley		
			Lupine - field pea		
			Field pea - spring barley		
020171111-001	2011	4	Spring oat - spring barley	Mixed cereals, spring sown	Organic
020171111-003			Spring oat -spring wheat		
020171111-004			Spring triticale - spring barley		
020171111-006			Spring triticale - spring barley - spring wheat - spring oat		
020041010-001	2010	6	Field pea, spring wheat	Pea production with good weed competition	Organic
020041010-002					
020041010-003					
020041010-004					
020041010-005					
020041010-006					
020071010-001	2010	2	Faba bean -spring triticale	Robust production of grain legumes	Organic
020071010-002			Faba bean - lupine		
			Lupine - spring triticale		





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			Lupine - spring barley		
			Field pea - lupine		
			Field pea - spring oat		
			Field pea - spring barley		
020171010-001	2010	6	Spring oat -spring barley	Mixed cereals, spring sown	Organic
020171010-002			Spring oat - spring wheat		
020171010-003			Spring triticale - spring barley		
020171010-004			Spring triticale - spring barley - spring wheat - spring oat		
020171010-005					
020171010-006					
020040909-001	2009	4	Field pea, spring wheat	Pea production with good weed competition	Organic
020040909-002					
020040909-003					
020040909-004					
020170909-001	2009	5	Spring oat -spring barley	Mixed cereals, spring sown	Organic
020170909-002			Spring oat - spring wheat		
020170909-003					
020170909-004					
020170909-005					
020370808-002	2008	2	Maize -soyabean	Mixed growing of maize and field beans	Organic
020370808-003			Maize - faba bean		
020360707-001	2007	2	Maize - faba bean	Mixed growing of maize, field beans	Organic





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				and scarlet runner	
020360707-002			Maize - runner bean		
			Maize - stangbønne		
020370707-003	2007	3	Maize - faba bean	Mixed growing of maize and field beans	
020370707-004					
020370707-005					
020360606-001	2006	1	Maize - faba bean	Mixed growing of maize, field beans and scarlet runner	Organic
			Maize -runner bean		
020230505-001	2005	6	Spring wheat - field pea	Mixture of spring wheat and grain legumes	Organic
020230505-002			Spring wheat - lupine		
020230505-003					
020230505-004					
020230505-005					
020230505-006					
220040505-001	2005	2	Oat -lupin	DEMO. Intercropping of cereals and legumes	Organic
220040505-002					
220050505-001	2005	2	Oat -lupin	Intercropping lupin and cereals	Organic
220050505-002			Spring wheat - lupin		
			Spring barley - lupin		
			Spring triticale - lupin		
010220505-001	2005	1	Field pea, fababean	Yield in mixture of field pea and faba bean	Conventional





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010220404-001	2004	1	Field pea, fababean	Yield in mixture of field pea and faba bean	Conventional
020230404-001	2004	2	Spring wheat - field pea	Mixture of spring wheat and grain legumes	Organic
020230404-002			Spring wheat - lupine		
020230404-003					
020230404-004					
020230404-005					
020230404-006					
020240304-001	2004	6	Spring barley - field pea		
-			Spring barley - lupine		
-			Spring barley - lupine - field pea		
-			Spring barley - faba bean		
022110404-001	2004	3	Spring wheat- lupine	Mixture of spring wheat and legumes maturity	Organic
022110404-002			Spring wheat - field pea		
022110404-003			Spring wheat - faba bean		
			Spring wheat - fodder vetch		
022120404-001	2004	2	Winter wheat - lupine	Maturity	Organic
022120404-002			winter wheat - field pea		
			Winter wheat - faba bean		
220030404	2004				
220040404	2004				





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030050303-001	2003	3	Field pea, grass, grass clover	Yield in mixture of field pea and grass mixture	Conventional
030050303-002					
030050303-003					
10210303	2003	1	Field pea, fababean	Yield in mixture of field pea and faba bean	Conventional
020220303-002	2003	1	Field pea, spring barley mixture	Reducing Ascochyta pisi in field pea in mixture with spring barley	Organic
020230303-001	2003	3	Spring wheat- field pea	Yield and quality in pure spring wheat and mixture with field pea and lupine	Organic
020230303-002			Spring wheat - lupine		
020230303-003					
020240303-001	2003	3	Spring barley - field pea	Kernel and proteine yield, mixture and pure stand	Organic
020240303-002			Spring barley - lupine		
020240303-003			Spring barley - faba bean		
			Spring barley - lupine - field pea		
020380303-001	2003	3	Spring wheat - lupine	Quality spring wheat in mixture with pulses	Organic
020380303-003			Spring wheat - field pea		
020380303-004			Spring wheat - faba bean		
020390303-001	2003	2	Winter wheat, lupine, field pea	Quality winter wheat in mixture with pulses	Organic
020390303-002					
022010303-001	2003	1	Spring barley - field pea	DEMO. Field pea and lupine in mixtures	Organic





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				with cereals	
			Oat - field pea		
			Spring barley - lupin		
			Spring wheat - field pea		
030050202-001	2002	1	Field pea, grass clover	Yield in pea	
020220202-001	2002	4	Spring barley - field pea	Reducing Ascochyta pisi in field pea in mixture with spring barley	Organic
020220202-002					
020220202-003					
020220202-004					
020240202-001	2002	3	Spring barley - field pea	Kernel and proteine yield, mixture and pure stand	Organic
020240202-002			Spring barley - lupine		
020240202-003			Spring barley - field pea		
			Spring barley - lupine		
			Spring barley - lupine - field pea		
			Spring barley - faba bean		
030090101-001	2001	3	Field pea, grass clover	Yield in pea	Conventional
030090101-002					
030090101-003					
020240101-001	2001	1	Spring barley - field pea	Intercropping of cereals and legumes	
020240101-002			Spring barley - lupin		
			Spring barley - field pea - lupin		Organic
022010101-001	2001	3	Spring barley - field pea	Proteine crops in spring barleay variety	Organic





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				mixture	
022010101-002					
022010101-003					
022020101-001	2001	3	Spring barley - field pea	Proteine content silage crops	Organic
022020101-002			Spring wheat - lupine		
022020101-003			Spring wheat - soybean		
			Field pea - quinoa - spring barley		
030110000-001	2000	2	Spring barley - field pea	Seedeing density oat/pea whole crop	Conventional
030110000-005			Spring oat - field pea		
030019999-001	1999	5	Spring barley, field pea	Barley/ pea varieties for whole crop	Conventional
030019999-002					
030019999-003					
030019999-004					
030019999-005					
020089999-001	1999	3	Field pea - lupine	Yield and feed quality in lupine and field pea	Organic
020089999-002			Spring barley - field pea		
020089999-003					
030049898-001	1998	5	Spring barley, field pea	Barley/ pea varieties for whole crop	Conventional
030049898-002					
030049898-003					
030049898-004					
030049898-005					





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030059898-002	1998		Field pea - IRG	Feed supply in silage and grass	Conventional
			Spring barley - IRG		
			Seed flax - IRG		
020149898-001	1998	3	Field pea - lupine		
020149898-004'			Spring barley - field pea	Lupin and field pea for whole crop	Organic
020149898-005					
20139898	1998				
30069797	1997		Spring barley, field pea	Barley/ pea varieties for whole crop	Conventional
030189797-001	1997		Field pea - IRG	Feed supply in silage and grass	Conventional
03018979-002			Spring barley - IRG		
03018979-003					
30119696	1996		Spring barley, field pea	Barley/ pea varieties for whole crop	Conventional
30059595	1995		Spring barley, field pea	Barley/ pea varieties for whole crop	Conventional
30049494	1994		Spring barley, field pea	Barley/ pea varieties for whole crop	Conventional
30079393	1993		Spring barley, field pea	Barley/ pea mixtures for whole crop	Conventional
30099393	1993		Ryegrass, field pea	Types of ryegrass in field pea whole crop	Conventional
20109393	1993		Barley, field pea	Silage	Organic
30189292	1992		Spring barley, field pea	Mixture for whole crop	Conventional
30209092	1992		Lucerne,	Mixture and pure stand of lucerne	Conventional
30209292	1992		Grass, field pea	Grass in field pae mixture	Conventional
20079293	1992		Barley, field pea	Maturity	Organic





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20109292	1992		Barley, field pea	Silage	Organic
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Appendix 3 – Overview of literature

Crop		Reference	Year	Titel	Contents
Web of Science					
Field beans-cereals		Lars Monrad Hansen , Louise Lorentsen & Birte Boelt	2008	How to reduce the incidence of black bean aphids (<i>Aphis fabae</i> Scop.) attacking organic growing field beans (<i>Vicia faba</i> L.) by growing partially resistant bean varieties and by intercropping field beans with cereals	<ul style="list-style-type: none"> • Intercropping field bean and spring wheat/spring barley (different seed rates) • Higher yield with intercropping • Less aphids with intercropping • Organic





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Pea-cereals		Arlauskiene, Ausra; Sarunaite, Lina; Kadziuliene, Zydre; Deveikyte, Irena; Maiksteniene, Stanislava	2014	Suppression of Annual Weeds in Pea and Cereal Intercrops	<ul style="list-style-type: none"> • intercropping pea, spring wheat, spring barley, oat and triticale. • Organic • Annual weed control • Pea-oat reduced weed density compared to pea-wheat • Compares intercropping with sole crops • Measurements of weed reduction: density, plant height, weed infestation, weed density, weed dry weight, grain yield, weed suppression
Wheat-maize		FangGou, Martin K.van Ittersum, GuoyuWang, Peter E.L.van der Putten, Wopkevan der Werf	2016	Yield and yield components of wheat and maize in wheat-maize intercropping in the Netherlands	
Legume-maize		Bilalis, Dimitrios; Papastylianou, Panayiota; Konstantas, Aristidis; Patsiali, Sotiria; Karkanis, Anestis; Efthimiadou, Aspasia	2009	Weed-suppressive effects of maize-legume intercropping in organic farming.	
Review om intercropping		Lopes, Thomas; Hatt, Severin; Xu, Qinxuan; Chen, Julian; Liu, Yong; Francis, Frederic.	2015	Wheat (triticum aestivum L.)-based on intercropping systems for biological pest control.	





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Wheat–pulses		M. J. Gooding, E. Kasyanova, R. Ruske, H. Hauggard-Nielsen, E. S. Jensen, C. Dahlmann, P. Von Fragstein, A. Dibet, G. Corre-Hellou, Y. Crozat, A. Pristeri, M. Romeo, M. Monti AND M. LAUNAY	2007	Intercropping with pulses to concentrate nitrogen and Sulphur in wheat	<ul style="list-style-type: none"> • Spring/winter wheat and faba bean • Increasing N and S concentration in wheat grain by intercropping with faba bean • Baking quality
Synthesis. Intercropping.		Rob W. Brooker, Alison E. Bennett, Wen-Feng Cong, Tim J. Daniell, Timothy S. George, Paul D. Hallett, Cathy Hawes, Pietro P. M. Iannetta, Hamlyn G. Jones, Alison J. Karley, Long Li, Blair M. McKenzie, Robin J. Pakeman, Eric Paterson, Christian Schob, Jianbo Shen, Geoff Squire, Christine A. Watson, Chaochun Zhang, Fusuo Zhang, Junling Zhang and Philip J. White	2014	Improving intercropping: a synthesis of research in agronomy, plant physiology and ecology	
Wheat–faba bean		Giacomo Tosti, Michela Farneselli, Paolo Benincasa, and Marcello Guiducci	2016	Nitrogen fertilization strategies for organic wheat production: crop yield and nitrate leaching	<ul style="list-style-type: none"> • Comparing different N fertilization strategies to evaluate their effect on winter wheat N uptake and N leaching • Wheat – faba bean
Pea-barley		Haugaard-Nielsen H., Gooding M. Ambus P., Corre-Hellou G., Crozat Y., Dahlmann C., Dibet A., von Fragstein P., Pristeri A., Monti M.,	2009	Pea-barley intercropping for efficient symbiotic N ₂ -fixation, soil acquisition and use of other nutrients in European organic	<ul style="list-style-type: none"> • Organic • More efficient use of N resources by pea-barley intercrops than sole crops • Less relevant





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		Jensen E.S.		cropping systems	
Pea-barley		H. Hauggaard-Nielsen M. Gooding P. Ambus, G. Corre-Hellou, Y. Crozat, C. Dahlmann A. Dibet, P. von Fragstein A. Pristeri M. Monti E. S. Jensen	2009	Pea-barley intercropping and short-term subsequent crop effects across European organic cropping conditions	<ul style="list-style-type: none"> • Organic • Pea-barley • Less relevant
		Hauggaard-Nielsen & Jensen	2001	Evaluating pea and barley cultivars for complementarity in intercropping at different levels of soil N availability	<ul style="list-style-type: none"> • Effect of pea-barley cultivars in intercropping
Legume-cereals		Igor Huňady and Miroslav Hochman	2014	Potential of legume-cereal intercropping for increasing yields and yield stability for self- sufficiency with animal fodder in organic farming	<ul style="list-style-type: none"> • Organic • Pea – spring barley/wheat • Pea to cereal ration • Forage yield • Stabilizing yield
Legume-cereals. Review		Bedoussac L., Journal E-P., Hauggaard-Nielsen H., Naudin C., Corre-Hellou G., Jensen E. S., Prieur L., Juste E.	2015	Ecological principles underlying the increase of productivity achieved by cereal-grain legume intercrops in organic farming.	
Pea-spring cereals		Aušra Arlauskienė, Stanislava Maikštėnienė, Lina Šarūnaitė, Žydrė Kadžiulienė, I rena Deveikytė, Vilma Žėkaitė, Rūta Česnulevičienė	2011	Competitiveness and productivity of organically grown pea and spring cereal intercrops	<ul style="list-style-type: none"> • Pea – spring barley/wheat/triticale/oat • Organic • Plant competition and yield





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Intercropping with colour		Timothy E. Farkas	2015	Fitness trade-offs in pest management and intercropping with colour: an evolutionary framework and potential application.	
		Dominic Lemken, Achim Spiller, Marie von Meyer-Höfer	2016	The Case of Legume-Cereal Crop Mixtures in Modern Agriculture and the Transtheoretical Model of Gradual Adoption	
Wheat - intercropping		Thomas Lopes, Séverin Hatt, Qinxuan Xu Julian Chen Yong Liud and Frédéric Francisa	2016	Wheat (<i>Triticum aestivum</i> L.)-based intercropping systems for biological pest control	
Organic Eprint					
Winter pea-triticale		Ankathrin Gronle, Jürgen Heß, Herwart Böhm	2015	Effect of intercropping normal-leaved or semi-leafless winter peas and triticale after shallow and deep ploughing on agronomic performance, grain quality and succeeding winter wheat yield.	<ul style="list-style-type: none"> • Organic • Improve winter pea survival • The effect of shallow ploughing on biomass production, yield and grain quality compared to deep ploughing • Impact of the intercropping on a succeeding wheat crop • Compared to sole crops





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Pea-oat		Annkathrin Gronle, Guido Lux, Herwart Böhm, Knut Schmidtke, Melanie Wild, Markus Demmel, Robert Brandhuber, Klaus-Peter Wilbois, Jürgen Heß	2015	Effect of ploughing depth and mechanical soil loading on soil physical properties, weed infestation, yield performance and grain quality in sole and intercrops of pea and oat in organic farming.	<ul style="list-style-type: none"> • Pea-oat • Organic • Impact of ploughing depth and mechanical soil loading • Compared to sole crops • Soil conditions, yield, weed infestation, grain quality. •
Lupin-cereals		Ullalena Boström	2004	INTERCROPPING NARROW-LEAFED LUPINS WITH CEREALS FOR WHOLE CROP HARVEST	<ul style="list-style-type: none"> • Lupin – wheat/barley/mix oat and barley • Whole crop silage • Organic • Competitive ability and yield
		J. Pozdíšek, B. Henriksen, A. Ponižil and A.-K. Løes	2011	Utilizing legume-cereal intercropping for increasing self-sufficiency on organic farms in feed for monogastric animals	<ul style="list-style-type: none"> • Pea – spring barley/spring wheat • Organic • Intercropping legume-cereal for nutritional effects on animal fodder
		Bedoussac, Laurent; Journet, Etienne-Pascal; Hauggaard-Nielsen, Henrik; Naudin, Christophe; Corre-Hellou, Guénaëlle; Prieur, Loïc ; Jensen, Erik Steen and Justes, Eric (2012)	2012	Eco-functional intensification by cereal-grain legume intercropping in organic farming systems for increased yields, reduced weeds and improved grain protein concentration	





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		Hauggaard-Nielsen, Henrik and Jensen, Erik Steen	2001	Evaluating pea and barley cultivars for complementarity in intercropping at different levels of soil N availability	
Common vetch – oat/triticale		A.S. Lithourgidis, I.B. Vasilakoglou, K.V. Dhima, C.A. Dordas, M.D. Yiakoulaki	2006	Forage yield and quality of common vetch mixtures with oat and triticale in two seeding ratios	<ul style="list-style-type: none"> • Common vetch-oat/triticale • Evaluate common vetch, triticale and oat in different seeding ratios for forage yield and quality and growth rate • Compared with sole crops
Common vetch - cereals		K.V. Dhima, A.S. Lithourgidis, I.B. Vasilakoglou, C.A. Dordas	2007	Competition indices of common vetch and cereal intercrops in two seeding ratios	<ul style="list-style-type: none"> • Common vetch- barley/oat/wheat • Competition among different species in intercropping systems with different seeding rates • Competition indices • resource management with respect to productivity (silage yield, competition and economic parameters)
		Henrik Hauggaard-Nielsen, Bjarne Jørnsgaard, Julia Kinane, and Erik Steen Jensen	2007	Grain legume–cereal intercropping: The practical application of diversity, competition and facilitation in arable and organic cropping systems	<ul style="list-style-type: none"> • Organic • Pea/faba bean/lupin-barley • Effect of dual intercropping on yield, grain quality, N use, weed growth and diseases





Appendix 4 - Overview of metadata from Core Platforms

Organization	Number of trials	Species	Summary of data and metrics available
CSIC	3	Winter: Faba bean/wheat Faba bean/barley Faba bean/wheat Pea/wheat Pea/barley	<ul style="list-style-type: none"> • Diseases severity • Weed cover • Weed biomass
JHI	4	Winter barley (conventional/sustainable) Spring barley (conventional/sustainable)	<ul style="list-style-type: none"> • Crop and weed cover • Crop yield • Soil carbon and soil pH • Aphid abundance, natural enemy activity • Weed biodiversity – seedbank
STC	2	Winter barley (conventional/sustainable) Spring barley (conventional/sustainable) Clover (direct drill/strip till)	<ul style="list-style-type: none"> • Crop establishment • Clover and weed covers • Arthropod survey – pitfall traps and water-pan catches, pollinator visual eye.
UNIVPM	5	Faba bean/pea	<ul style="list-style-type: none"> • Plant and canopy height • Seed yield, number of seeds pr. plot, seed weight. • Seed qualitative analyses • Lodging • Sowing date, harvest date • Pct. Yield in mixture of single species • Average TKW
L&F SEGES	2-3	Lupin/pea Lupin/spring wheat Pea/spring wheat	Unknown. Will be public when trials for 2018 are planned.





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Appendix 5 – Data capture form



WP5_Template_data
et_final.xlsx





Appendix 6 – Guideline for completion



The project has received funding from the European Union's Horizon 2020 research and innovation programme under agreement No. 727284

WP5 - Capture form and description

Guideline to fill out the dataset template with metadata, treatments and registrations.

1. Overall guideline:

The spreadsheet is a skeleton of data that should be incorporated in the final dataset for further use in the Decision aid (output of WP5).

If no data exist, please mark it with a dot (.) in the template meaning “no data available”.

The parameters are being reviewed in the following and only those where we find, that there could be any doubt, is elaborated.

We encourage you to read the capture form carefully before filling in data and to use it as a guide throughout the process.

1.1 Metadata:

The sheet metadata is to identify all metadata from the experiment. Some categories are prefilled with a dropdown menu to ease the work. All the data are entered horizontally in the sheet.

1.2 Treatments and Registrations:

This sheet is to collect all relevant data on entry (treatment) level. The metric value for each parameter is mentioned in each type of registration.

If the predefined registrations aren't sufficient it is possible to create a new column in the end of the spreadsheet under “OTHER”. See section 3.10.





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All treatments are entered and the relevant options for each treatment are selected horizontally in the sheet. That means that not all options are relevant to every treatment, but that they must be selected for each individual treatment.





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2 METADATA

This sheet is for all metadata information describing general data and not direct treatments or registrations. Fill in one row per trial.

2.1 ID

Trial identification: The first crucial point is to identify the data. Data should be possible to identify through the process of data management, therefore it is very important to write the ID of the trial in both the “*Metadata*” sheet and the “*Treatment and registrations*” sheet.

ID Trial should be the identification of the trial and should be defined by each field experiment leader.

Year of the trial and **growing season** is also a way of identifying the data. **Year** is the year the experiment is harvested, please make a note on year of establishment,

2.2 OWNERSHIP AND USE OF DATA

To be able to:

- Identify owner of data
- Quote the authors correct
- Get in touch with the right person for further questions
- Publish the data correct

2.3 DATA DESCRIPTION

Origin of data is defined by a dropdown menu and describe where data is produced: Within Diversify, data from partners or external data.

Type of data is defined by a dropdown menu and describe the quality of data: Scientific data, on farm data, or data from farmer demonstrations.

Scientific data is defined as research done by a University or similar level.

On farm data is defined as experiments conducted in farmers' fields with repetitions done by a persons in the profession of conducting trials.

Farmer demonstrations is defined as experiments done in cooperation with farmers or e.g. participatory farmers with sparse or no measurable yield or repetitions.





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2.4 TRIAL LOCATION

Should be defined very specific.

EU region is defined by the geographic spread from the application and is listed in a dropdown menu.

Atlantic (UK, France, Denmark),
Continental (Germany, Austria),
Alpine (Switzerland),
Mediterranean (Spain, Portugal, Italy).

2.5 CLIMATE

Information on precipitation and temperature.

2.6 TYPE OF TRIAL

Overall purpose should be a short sentence describing the trial very general. Like e.g. *Robust production of legumes, Spring sown mixed cereals, Pea production with good weed Competition.*

Description of specific purpose should specify more detailed the purpose of the trial. E.g. *Testing grain legumes in mixtures with spring cereal to measure stability and yield, Different spring cereals in mixture to stabilize yield, testing different varieties of field pea in different mixtures to experience their weed competition.*

2.7 FARMING SYSTEM

Experiment type is plots in field, glasshouse, and climate cabinet.

Type of production is whether the system is grown conventional or organic.

Farm type refers to the specialization, regarding arable or animal production. Crop rotation, crops, available manure and often defined by the type.

Precrop is the crop in the same field the previous year.

Irrigation mm should describe the amount of irrigation added. If this factor is unknown use (.).

Conservation tillage should be defined with yes/no. If yes please include a description of the system.





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2.8 SOIL PROPERTIES

Soil type and **soil sub type** should be chosen from the dropdown menu.

Clay, sand, gravel, silt, humus content and soil organic carbon should be written separately

and in percentage of soil.

N-min (mineralized Nitrogen) should be defined prior to the experiment and in four different depth

(0-25 cm, 25-50 cm, 50-75 cm and 75-100 cm). The N-min test should be conducted after ISO

14256 standards. Please insert new columns if other soil depths are used and define the depths of the measurement

Available phosphorous should be given in an approved method like e.g. Olsen method, Morgan

method, CAL, Pw. The important thing is that the method should be described in **method.**

Extractable potassium should be given in an approved method and should be described in

method.

pH in soil should be given in an approved method and should be described in **method.**

2.9 BASIC TREATMENTS (treatments conducted in the entire trials)

Soil cultivation before sowing is the soil cultivation actions done before sowing, like e.g.

ploughing, harrowing etc. All actions should be listed separated by a comma (,).

Type of fertilizer is defined as chemical fertilizer, manure or organic fertilizer (not manure).

Organic fertilizer is other organic types of fertilizer than manure like e.g. bone meal, garden waste,

distillery residues. Things often used in organic farming.

Type of pesticide and date here it should be written which pesticide (herbicide, fungicide etc.) is used and the amounts like:

name/dosage. All pesticides in the same category e.g. all herbicides used in the experiment,

should be listed at the same time.

If the same treatment isn't used in the whole experiment, it should be written in the "Treatments and registrations" sheet instead.

2.10 STATISTICS

Data is collected on entry level, not plot level.





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Columns are made for **LSD and p-value** on yield for each species in the mixture. For each factor 1,2,3 or more and interactions between factors 12, 13, 23 and 123. Please enter relevant statistics in a similar way for the other measurements.

2.11 OTHER

Relevant information on trial level, not included in the previous information.

2.12 EVALUATION OF THE TRIAL

Overall evaluation of the trial and all information on trial conditions relevant to the use of data, e.g. late sowing date, bad sowing conditions, insufficient treatments, other hazards to the trial, harvest problems.





3 TREATMENT AND REGISTRATIONS

This sheet is for registrations made at entry (treatment) level. Fill in one row per treatment. The requested data is on entry level, not plot level.

If this sheet isn't sufficient for your individual data, it is okay to create new columns. They should be created in the end of the sheet (notated "other") following the procedure with information on treatment coupled with BBCH growth scale.

The plan is to use a standard unit of measures for all the data, which is predefined in the sheet. If the predefined unit of measures isn't sufficient or if data doesn't fit the sheet, there is a flexibility to accept different units depending on the dataset. Then the procedure should be to add units and method to the specific categories, to ensure as much data is included as possible.

Examples of other units could be sowing density (seeds/m²), seed yield (t DM per ha.).

3.1 ID

Trial identification: The first crucial point is to identify the data. Data should be possible to identify through the process of data management, therefore it is very important to write the ID of the trial in both the "Metadata" sheet and the "Treatment and registrations" sheet.

ID Trial should be the identification of the trial. Same as in the Metadata sheet.

ID Treatment should be the identification of the trial at entry (treatment) level.

There are no requirements for how the data should be named, just as long as it is possible to identify.

3.2 SPECIES INFORMATION

Species1, species2, species3, % of seed rate in pure stand is to identify the proportion of species in the mixture. The percentage of each species should be written as the percentage of the seed rate in pure stand.

The datasheet is prepared for tree species in a mixture. If you have mixtures containing more species please copy and paste the relevant columns and rename them with species4, species5 etc. Use this procedure for all the species relevant treatments and registrations.

3.3 SOWING:

Sowing density and **sowing depth** should be given for each species in the mixture.

Information on the row pattern for each species should be identified if the species are sown in the same row or separate rows.

Row distance cm (same row) is the distance between rows where species are sown in the same row





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Row distance between same species cm (separate rows) is the distance between the rows with the same species

Row distance between different species cm (separate rows) is the distance between the rows with different species.

3.4 AFTER EMERGENCE/WEEDING/WINTER

In these groups. a lot of traits might be registered together with the growth stage of the crop, therefor please fill in BBCH growth stage (same color in the sheet).

If this category is insufficient, please create new columns in the end of the sheet (notated "other") following the procedure with information on treatment coupled with BBCH growth scale.

For more information on BBCH growth stage see appendix.

3.5 GROWING SEASON, CROP DESCRIPTION

If registrations are made more than once in the growing season, please copy paste the column you need. Remember to include growing stage.

3.6 WEEDS

Every assessment here should be coupled to the BBCH growth scale of species1.

Total weed cover of ground, monocot weed cover of ground and dicot weed cover of ground is visual assessments in percentage.

Monocot – and dicot weed cover is assessed with plant cuts.

3.7 DISEASES

There are no prefilled diseases. It is possible to fill in data on the relevant diseases for each treatment. Please copy and paste the columns if space for more disease registrations are required.

If there are no diseases this should also be noted.

For each disease, please fill in the following: *Disease, species, part of plant covered, percentage of cover, BBCH growth stage of the plant.*

Example: *Powdery mildew (Erysiphe graminis), spring barley, green leaves, 2 %, BBCH St. 57.*





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3.8 PESTS

There are no prefilled pests. It is possible to fill in data on the relevant diseases for each treatment. Please copy and paste the columns if space for more pest registrations are required.

If there are no pests this should also be noted.

For each pest, please fill in the following: *Pest, plant species, part of plant covered, percentage of cover, BBCH growth stage of the plant.*

Example: *Aphids (Aphis fabae), faba bean, whole plant, 5%, BBCH St. 74.*

3.9 COMBINE YIELD AND QUALITY

All assessments that describe the yield of the mixture (total and divided in species) and the species in pure stand.

3.10 BIOMASS YIELD AND QUALITY

A description of the different assessments regarding biomass or harvest of whole crop.

3.11 OTHER

In this category, it is possible to create new columns which are not included in the template. Requirements for creating new columns are to inform about *type of registration, species, metric value for the registration, methods and BBCH growth stage.*

The original template is made to fulfill a minimum level of registrations for the decision aid, but if there are some valuable data not included, it is relevant to add.

