



THIS PROJECT IS FUNDED BY THE
EUROPEAN UNION HORIZON 2020 RESEARCH
AND INNOVATION PROGRAMME UNDER
GRANT AGREEMENT 817690



CropBooster-P

Deliverable 1.4

Title: Preparatory documents ready for discussions during workshop with (core) SHG on nutritional improvement

Start date of the project: **November 1st, 2018** / Duration: 36 **months**

Planned delivery date: M5 (March 2019)

Actual submission date: 31 March 2019

Work package: WP1 / Task: 1.3

Work package leader: ULANC

Deliverable leader: UCPH

Version: Draft 1

Date of version: April 2019

Dissemination level	Public



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1. Introduction

Nutritional quality remains a major focus area in plant breeding for the continued improvement of agronomic traits and future crop optimization. With the growing demands for increased productivity and limitations in arable land and nutrient availability, the need for nutrient provision and uptake optimization in a sustainable manner gains significance. Obtaining an overview on the current state of nutritional quality crops produced within Europe including methods, technologies and pathways would therefore provide an insight into various aspects of plant improvement and nutrition security, contributing to a toolbox that would prove invaluable to the future directions of crop research.

The WP1-Research toolbox Task 1.3 will comprise of a broad overview of the current methods and approaches to improve crop nutritional quality. This will include a survey of published scientific literature for all major aspects of crop nutrition- spanning nutritional quality (ie, macronutrients, micronutrients, specialized metabolites and anti-nutrients) in major, minor, niche and aquatic crop species. Methods to improve nutritional quality, current and future technologies to improve crop nutrition and existing geographical trends with respect to nutrition will be included in this study.

Additionally within the scope of Task 1.3 is to contribute to crop nutritional quality related trends in conjunction with Task 1.1 as preparatory material for the stakeholder group meeting.

2. Objectives

WP1-Research toolbox Task 1.3 aims to map existing and putative future areas, strategies and technologies (including modelling approaches) with the potential to improve nutritional quality in different crop species relevant to selected Geographical regions of Europe (NW,SE, Central-East). The current, updated methods and techniques used to evaluate the nutritional quality of different crops (eg. HPLC, NMR NIR/FTIR) will be logged and the different identified options to improve nutritional quality taking major and underused/underdeveloped terrestrial and aquatic crops and technologies with economic potential and value for Europe will be listed. Trade-offs between nutritional quality and yield will be included.

A second objective of the task is to provide support towards WP1-Research toolbox Task 1.1 in building trend cards for the stakeholder group workshop that will identify main drivers and uncertainties crucial for futureproofing our food system and the European bio-economy.

3. Partners and fields of expertise

Organisation name	Short name	Country	Area(s) of specialization
Københavns Universitet	UCPH	Denmark	<ul style="list-style-type: none">• photosynthesis; regulation of photosynthesis, chloroplast biology, thylakoid membrane• plant development, microProteins, tissue culture
Consiglio Nazionale delle Ricerche	CNR	Italy	<ul style="list-style-type: none">• Secondary metabolism, evaluation of phenols, antioxidant activities of plant extracts, identification/separation of bioactive compounds by HPTLC, HPLC, NMR• antioxidants and bioactive components in food products, nutraceutical studies using cellular and animal models• Reduction of antinutritional factors and modulation of bioactive molecules in seeds by



Organisation name	Short name	Country	Area(s) of specialization
			genetic, genomic and biotechnological approaches, mineral biofortification of seed crops <ul style="list-style-type: none">New breeding technologies for biofortification of tomato and other horticultural crops, nutritional assessments on biofortified crops or underutilised varieties
Europese Organisatie voor Wetenschappelijk Plantenonderzoek	EPSO	Belgium	
Heinrich-Heine-Universitaet Duesseldorf	UDUS	Germany	
Julius Kuehn-Institut Bundesforschungsinstitut fuer Kulturpflanzen	JKI	Germany	<ul style="list-style-type: none">New molecular technologies in agriculture – incl. improvement of food/feed qualitygenome editing in different plants
Centre National de la Recherche Scientifique	CNRS	France	<ul style="list-style-type: none">essential metal (Fe, Mn) transport and seed storage, toxic metal uptake in plantsbiochemistry, metabolic engineering and functional analysis of plant metabolism
University of Nottingham	UNOTT	UK	<ul style="list-style-type: none">plant and crop physiology, wheat, rice, photosynthesiscrop physiology, agronomy, drought, nutrient use efficiency, nitrogen, wheat
Institut National de la Recherche Agronomique	INRA	France	<ul style="list-style-type: none">quantitative genetics, genetic control of tomato fruit quality (sensory and nutritional), fruit and vegetable quality in general
University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca	USAMV CLUJ	Romania	<ul style="list-style-type: none">Biochemistry of plant phytochemicals, Advanced techniques for phytonutrients' encapsulation, Analysis (Identification/separation) of bioactive compounds from plants and food by LC-MS, FTIRFood biotechnology, Microencapsulation of probiotics, Molecular gastronomy, Biofortified crops
ARVALIS Institut du vegetal	ARVALIS	France	<ul style="list-style-type: none">crop nutrition (cereals, maize and potato) linked to crop production (quantity-quality), nutrient cycling in the soil and genetics

4. Meetings and teleconferences

The following meetings and teleconferences have been held to discuss the project status:

- 27 Feb 2019 Teleconference- Work package leaders**
Defined the scope of data assimilation and collection format.
- 7 March 2019 Teleconference- WP1 Task 1.3 partners**



Discussed format of data collection, level of detail, deliverables and assigned responsibilities according to expertise and areas of interest. Created shared folder for internal data collection. Data collection in progress.

- **3 April 2019 F2F Meeting WP leaders-** Discuss template and data collection model

Future events:

- **Mid-April and Mid-May-** follow up calls to WP 1 Task 1.3 members
- **Mid June-** F2F meeting with members of task 1.3

5. WP1 Task 1.1 Trend cards:

In preparation for the scenario building workshop, a list of relevant trends and issues focusing on subtask nutrition was collected from among the partners and assimilated into a long list of trends. These were further sorted according to relevance to the CropBooster-P project. A final shortlist of trends was proposed which contained trends pertaining to crop yield, nutrition and sustainability subtasks. These trends were then further processed into trend cards.

List of trends considered for Scenario Building

Trends (in alphabetical order):


- | | | |
|---|-----------------------------------|--|
| 1) Aging Population | 17) Economic Pressure on Farms | 32) Power of the Online Public |
| 2) AI & Big Data | 18) Electrification | 33) Product & Research Regulation |
| 3) Alternative Nutrition Sources | 19) Environmental Concerns | 34) Public Engagement in Research |
| 4) Animal Welfare | 20) Fair Trade | 35) Reduction of / Altered Genetic Resources Circulation |
| 5) Biofortification | 21) Globalization | 36) Renewable Energy |
| 6) Biotech | 22) Healthy Lifestyle | 37) Resource Scarcity |
| 7) Blockchain | 23) ICT on the Rise | 38) Rising Disposable Income |
| 8) Cheaper Food | 24) Increased Mechanisation | 39) Risk Sensitivity |
| 9) Circular Bioeconomy | 25) Intellectual Property | 40) Robotics |
| 10) Climate Change | 26) Land-Use Pressure | 41) Self-Tracking / Quantified Self |
| 11) Cultivar / Species Mixtures | 27) NBTs & Genetic Modification | 42) Sustainability |
| 12) Decline of Pollinators & Biodiversity | 28) Offering of Meat Alternatives | 43) Transparency |
| 13) Declining Chemistry for Pest Control | 29) Organic Farming | 44) Urban Farming / Greenhouses |
| 14) Diet-related Chronic Diseases | 30) Plant Beneficial Microbes | 45) Urbanization |
| 15) Do-it-Yourself | 31) Population Growth | |
| 16) E-Commerce | | |

Trend Card

Plant Beneficial Microbes

Description

As the discovery of new synthetic pesticides has become increasingly costly, the biopesticide market has been growing, including the exploration and use of plant beneficial microbes. These can act preventatively, suppress diseases, enhance the availability of nutrients and promote plant growth and rooting.



<p>Facts & Figures</p> <ul style="list-style-type: none"> - Increasing investment of agri start-ups in microbiome - Ca. €400M spent on "microbiome related research" in the first 2 years of H2020 (EU), investment up to €130M foreseen until 2020 - The global human microbiome market would be worth USD 0.3 billion by 2019, and reach USD 0.7 billion by 2023 - Rising number of scientific papers on microbiome research [2769 [2012] to 8431 [2016]] 	<p>Stakeholders & Influencers</p> <ul style="list-style-type: none"> - Researchers/startups (seek funding, innovate) - Consumers (demand) - Farmers (supply) - Supermarkets/retail (promotion) - Government (regulation) - NGOs (certification) <p>Related (Sub-)Trends</p> <p>Pesticide free agriculture, Sustainability, Bio Boom</p>	<p>Relevancy: CropBooster-P</p> <ul style="list-style-type: none"> - Influence on land use, crop sustainability and productivity - Reduced acceptance of conventional CPM - Influence on food prices - Enable new business models - Certification and regulation (synthetic pesticides/fertilizers vs. biologicals)
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Fig. Final list of list of trends to be considered at the scenario building workshop in alphabetical order (above) and Example of a trend card for the scenario building workshop (below). Trends span aspects relating to crop yield, nutrition, and sustainability.

Trend cards capture the key aspects pertaining to each trend for consideration by the stakeholder group. These include facts and figures relating to the trend, examples of key stakeholders and influencers, the related sub trends and the relevance for the CropBooster-P project.



6. WP1 Task 1.3 Work plan

6.1 Phases:

WP1 Task 1.3 has been divided into 3 smaller phases to facilitate data collection:

- 1) Definition of template, division of tasks among partners according to expertise and areas of interest.
- 2) Data collection/ filling templates (M7-M8)
- 3) Compilation and filling in the gaps in the collected data, arranging the collected information in a comprehensive format and upload to a central location (M7-M8)

6.2 Definition of template:

A common template between the subtasks of work package 1- **yield, nutrition** and **sustainability** is being developed in order to facilitate data collection and assimilation of overlaps between the subtasks for the final deliverable.

This template will form the basis of a longer document outlining the current scientific progress and approaches known to improve plant traits.

A technical annexe will also be included to summarize key technologies and methods to improve crop yield, nutrition quality and sustainability.

The major sub-traits pertaining to crop nutritional quality which will be considered within the template for data collection are:

- Nutritional quality in major crops
- Nutritional quality in niche crops/ Underutilized crops
- Nutritional quality in aquatic crops
- Macronutrients
- Micronutrients
- Geographical trends
- Toxicity/ anti-nutrients

Within each of the sub-traits, major components- pathways, genes, methods and techniques to evaluate nutritional quality in different crops will be considered.

7. To be discussed at the workshop

Within the scope of task: (what data collected will account for)

Documentation of traits, processes and pathways pertinent to crop nutrition. This includes:

- Current trends/ state of crop nutrition within Europe
- Methods to improve and optimize nutritional yield/ content in crops
- Nutrient availability (to the crops)
- Breeding technologies relevant to nutrient use efficiency, uptake and metabolism
- Transferable technologies (value capture)
- Synthetic biology to enhance nutrition
- Documentation of current state of nutrient categories per crop type: Carbohydrate, protein, fats, vitamins and minerals
- Aquatic crops
- Niche/ underdeveloped/ potentially beneficial crops
- Food and fodder crops
- Specialized metabolites with nutritive scope
- Toxic compounds/ anti-nutrients
- Document pathways, genes involved and orthologues



- Tradeoffs between nutrition and yield and nutrition and sustainability (to contribute to WP1.5 eventually)
- Spatial distribution of nutrients/ partitioning
- Nutrient uptake/ availability changes based on Geographical location within Europe

Outside the scope of this task: (what data collected will not account for)

- Nutrient trends outside Europe/ non-European crops
- Non measurable traits/ traits without genetic basis
- Social/ethical/environmental/physical factors (eg. GMO debate, global warming, weather inclemency and pests)
- Projections- predicting nutrient trends for future. (Capture current state of the art)
- Organoleptic quality (taste, smell...)

8. Deliverables

The following WP1 Task 1.3- specific deliverables are planned:

Number	Deliverable Title	Lead beneficiary	Type	Dissemination level	Delivery month
D 1.4	Preparatory documents ready for discussions during workshop with (core) SHG on nutritional improvement	UCPH	Report	Public	6
D1.5	Digested outcome and recommendations of the workshop regarding nutritional improvement	UCPH	Report	Public	8