



## **CropBooster-P**

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## EXECUTIVE SUMMARY

The interlinked challenges of population growth, climate change and shifting diets have put the future of food and farming firmly in the spotlight. CropBooster-P aims to develop a roadmap to future-proof European crops for these challenges – to do so, it is employing a stakeholder-focused approach to determine the impacts of various strategies for crop improvement.

In Work Package 2 we held 10 online workshop focus groups with 35 participants from across the European agri-food sector to understand the potential impacts of these crop improvement strategies. Farmers and farmer organisation representatives, non-governmental organisations, policy makers, plant breeders, agri-business association representatives and consumer experts were all invited to scrutinise 15 crop improvement options developed by Workpackage 1 of the Project.

These workshops allowed us to understand a wide range of potential social, economic and environmental impacts from different CropBooster options. Important themes for the development of the CropBooster roadmap were also identified, such as consideration for:

- **The trade-offs and knock-on effects for particular crop improvement strategies;** such as the potential for decreasing negative and toxic compounds in the plant to weaken resistance to pests and diseases
- **How the impacts of certain crop improvement strategies vary geographically;** including the likelihood of certain options, such as salt stress, being relevant to only a few European regions
- **Whether non-plant breeding mechanisms could better meet specific societal, economic or environmental aims;** for example, the potential for improving dietary choices among European consumers to improve nutritional outcomes rather than breeding for these aims

Alongside the workshop focus groups an online survey assessed how key stakeholders prioritised the broader goals of CropBooster-P – increasing crop yield, maintaining crop nutrition and improving crop sustainability – as well as the 15 discrete options for crop improvement. The survey demonstrated a preference for sustainability options, such as improving plant water use and improving heat stress tolerance (see **Figure 1**).

Option	Farm-level	Agri-business	Consumer	Plant scientists
Improving plant water use				
Improving heat stress tolerance				
Improving Nitrogen uptake and use				
Improving Phosphorous uptake and use				
Increasing antioxidant content				

**FIGURE 1: OPTIONS SELECTED AS 'VERY IMPORTANT' BY EACH STAKEHOLDER GROUP, AS DETERMINED BY OPTION PREFERENCE MEDIANS\***

**\* DARK BLUE INDICATES THAT THE MEDIAN PREFERENCE FOR THIS STAKEHOLDER GROUP FOR THIS OPTION IS 1 (EQUIVALENT TO 'VERY IMPORTANT')**



This report has been divided by specific Workpackage 2 tasks, which focus on different levels of the agri-food sector: Task 2.1 focusses on farm-level impacts, Task 2.2 on agri-business impacts and Task 2.3 on consumer-level impacts. The Introduction and Methods sections are shared across all three deliverables.



# 1 INTRODUCTION

## 1.1 Aims

In working papers D2.1 D2.2 and D2.3 we share initial findings from Work Package 2 (WP2), which aims to assess the the potential economic, social and environmental impact of the CropBooster options for improving yield, sustainability and nutrition arising from Work Package 1 (WP1) of CropBooster-P. This document serves as a shared introduction and explanation of methods for the three deliverable working papers D2.1-3.

## 1.2 Introduction to CropBooster-P

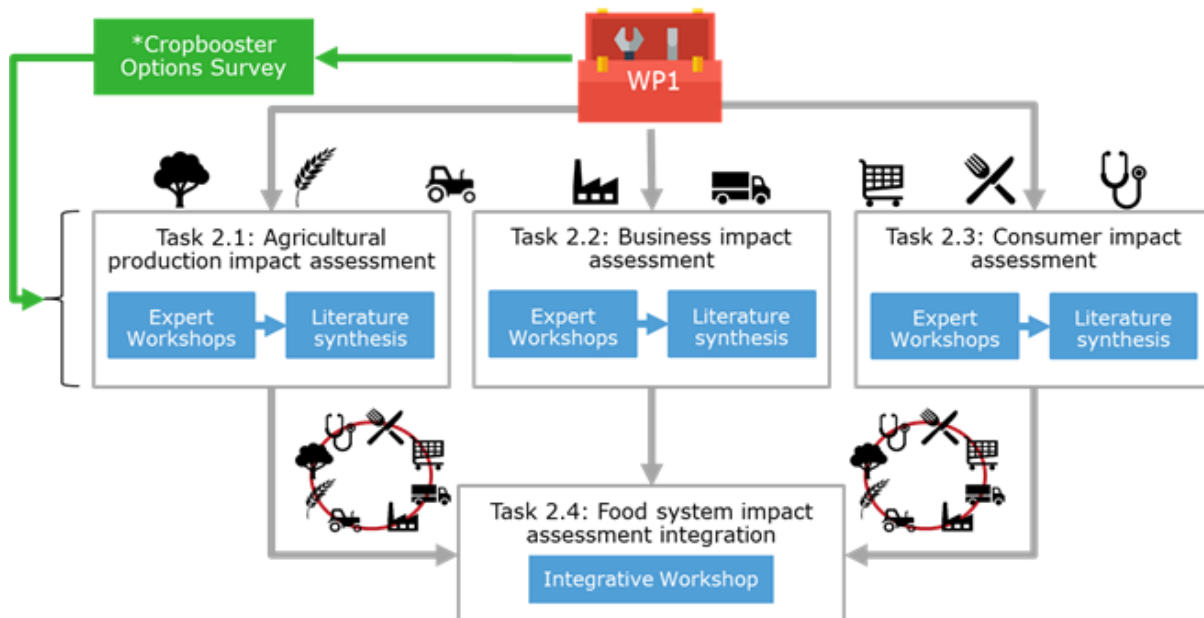
Food security, population growth and improving crop yields in the face of climate change are some of the greatest challenges facing humankind. We will need to feed 9.7 billion people in a sustainable way by 2050, whilst transitioning from a fossil fuel-based economy towards a bioeconomy in order to mitigate the effects of global climate change. This will require a doubling of global crop productivity to produce enough plant biomass to achieve both food and nutrition security, as well as to meet the demands of a future bioeconomy. Projections from the current rates of crop yield increases suggest we will fall 40-70% short of future demand. Increasing crop production must be achieved whilst maintaining crop nutritional quality and will require crops that combine sustainability, efficient use of scarce resources (e.g. water and minerals) and cultivation schemes and practices that preserve Earth's biodiversity. The crops must also have good yield stability with a high resilience to adverse climate and volatile weather conditions.

To meet these aspirations, our current crop plants need to be re-designed and thus mapping out how they can be "future proofed" is urgently needed. Progress could be mired by the complexity of a multitude of possible crops and genetic changes, combined with multiple environmental changes, policy and societal challenges. CropBooster-P is a Coordination and Support Action within the EU H2020 research programme that aims to address this by identifying opportunities to adapt and boost productivity in a background of environmental and societal changes. The Cropbooster-P objective is the development of a roadmap for future proofing our food system and the European bioeconomy, with a specific focus on making crop production more sustainable, resilient, and responsible, while at the same time guaranteeing nutritional food quality. Taking a Responsible Research and Innovation (RRI) approach, CropBooster-P involves key stakeholders, such as scientists, business, farmers, consumers/citizens, and policy makers, to align the process and its outcomes with the values, needs and expectations of society, such as the demand for adequate and sustainable supply of affordable and nutritious food that has been produced with acceptable environmental impact, taking into account that agricultural activity must be commensurate with the demand for food. The roadmap will minimize environmental impacts and provide routes to adapting to environmental change whilst strengthening the bioeconomy.

## 1.3 Overview of Work Package 2

Work Package 2 (WP2), as illustrated in Figure 1, takes a mixed-method, stakeholder-focused approach to understanding the potential economic, social, and environmental impacts of

options for future-proofing crops in Europe, identified in WP1 (see Error! Reference source not found.).

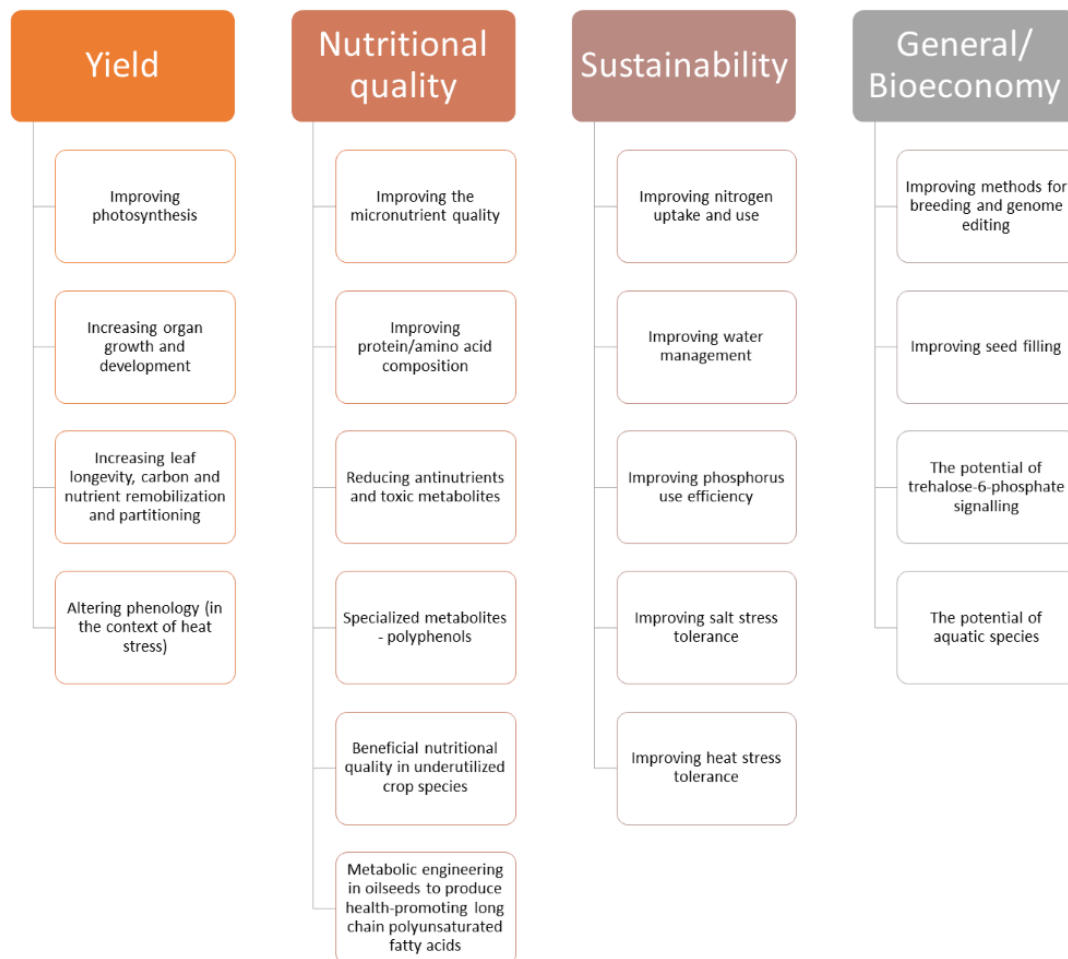


**FIGURE 2: TASKS AND APPROACH IN WP2. \*THE SURVEY, SHOWN IN GREEN, WAS ADDED TO THE ORIGINAL PLAN TO INCREASE THE ROBUSTNESS AND RESILIENCE OF THE DATA COLLECTION AND INFORMS THE LITERATURE SYNTHESIS ELEMENTS.**

In Tasks 2.1 to 2.3, respectively, we hosted a number of workshop focus groups centred on three key points in the food system/bioeconomy: at farm-level, in agri-businesses and the food and feed supply chain, and at the consumer level. We gathered expert stakeholders from these three areas in a series of online mini-focus groups to discuss: which crop improvement goals and options arising from WP1 they felt were a priority for the future of Europe, and what would be the social, economic and environmental impacts of adopting these options. This produced deep qualitative insights. We complemented these insights with the addition of an online survey, that provides quantitative data on crop priorities from a wider range of participants. The outcomes of these activities inform the scope of later literature syntheses on environmental, social and economic impacts. These expert and literature insights will then be integrated via a multi-actor workshop to provide a food-system impact assessment (in Task 2.4).

## 1.4 Cropboosting goals and options

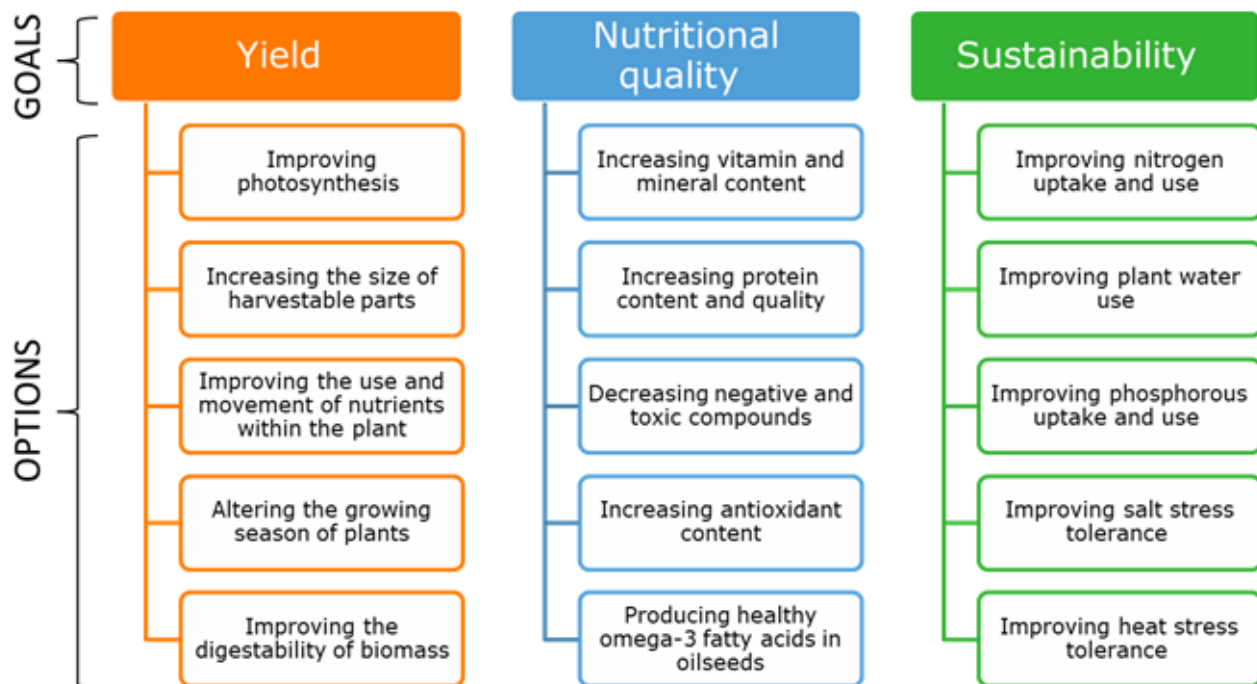
Work Package 1 identified a toolbox of “cropboosting” crop improvement options and technologies, drawing on the state of the art from the plant science community (as shown in **Figure 3**). These options were grouped under the three overarching CropBoosting “goals” of the project: increasing yield, nutritional quality and sustainability. We acknowledge that some options are interconnected and may deliver across two or more goals. However, the option primarily corresponds to the goal under which it has been categorised. This alignment to the goals allows us to tie the outputs to the overarching aims of CropBooster-P and helps to structure our communication and the resulting priorities of various stakeholders.



**FIGURE 3: INITIAL CLASSIFICATION OF CROPBUSTER AIMS AND OBJECTIVES**

We also had to ensure that the CropBooster crop improvement options could be understood and assessed by specialist (i.e. plant breeder) and non-specialist stakeholders. This began a process of refinement of WP1 outputs. Through consultation with WP1 and WP2 researchers, the CropBooster options were simplified and harmonised as outlined in **Figure 4**.





**FIGURE 4: CROPBOOSTING GOALS AND OPTIONS USED IN WP2, AS SUMMARISED FROM THE KEY POINTS IN WP1, TASK 1.5.**

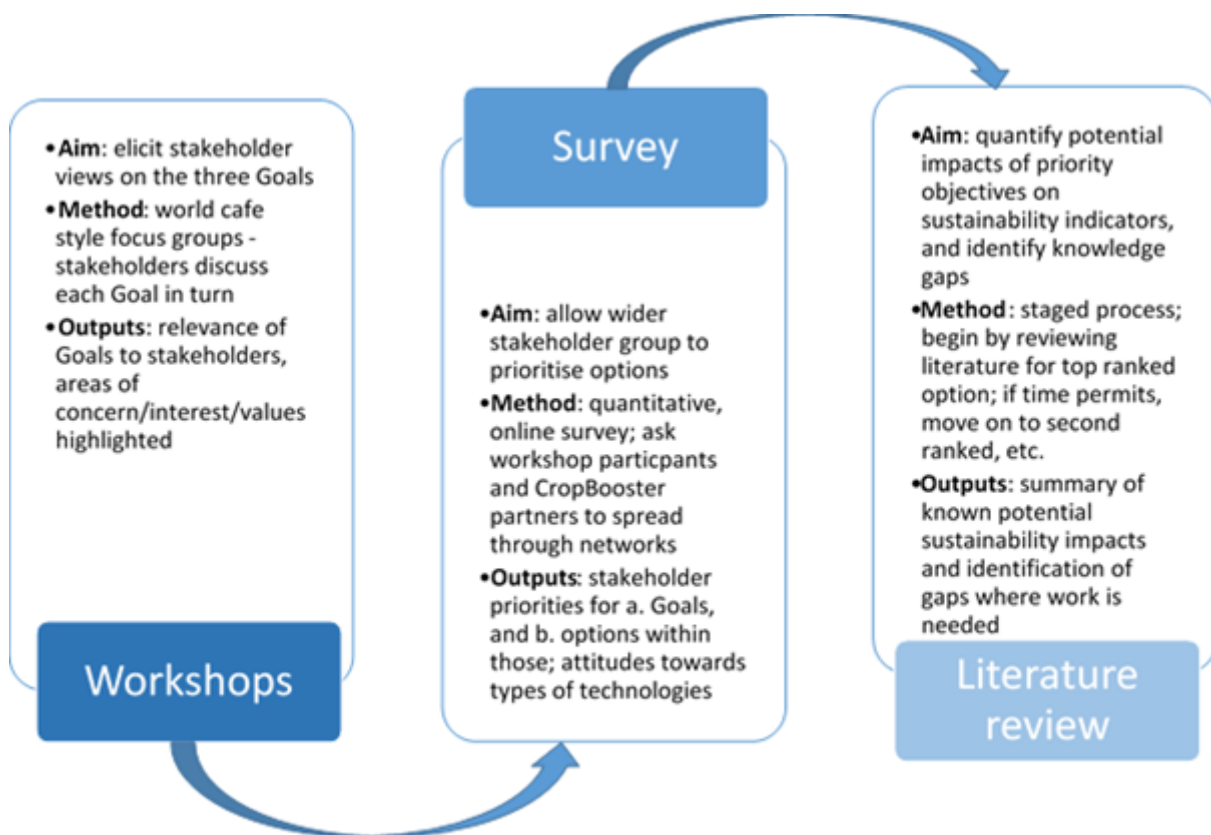
These options were presented to stakeholders through a series of workshops and through an online survey, the methodology of which is described below.

## 2 METHODS

The methodology of the study can be described as mixed-methods, combining qualitative data derived from focus groups to identify topics and quantitative data – in the form of a survey – and narrative analysis through a systematic literature review to consolidate the findings (see **Figure 5**). Described here are the methods employed in the first two components of the study.

### 2.1 Workshop focus groups

In order to understand the potential impacts of different future-proofing strategies for European agriculture, a series of virtual focus groups were held with relevant agri-food stakeholders from across Europe. Ethical approval by Lancaster University Faculty of Science and Technology Research Ethics Committee was granted (reference: FST19070), which outlined the overall protocols of the study, what types of data would be collected and how it would be managed.

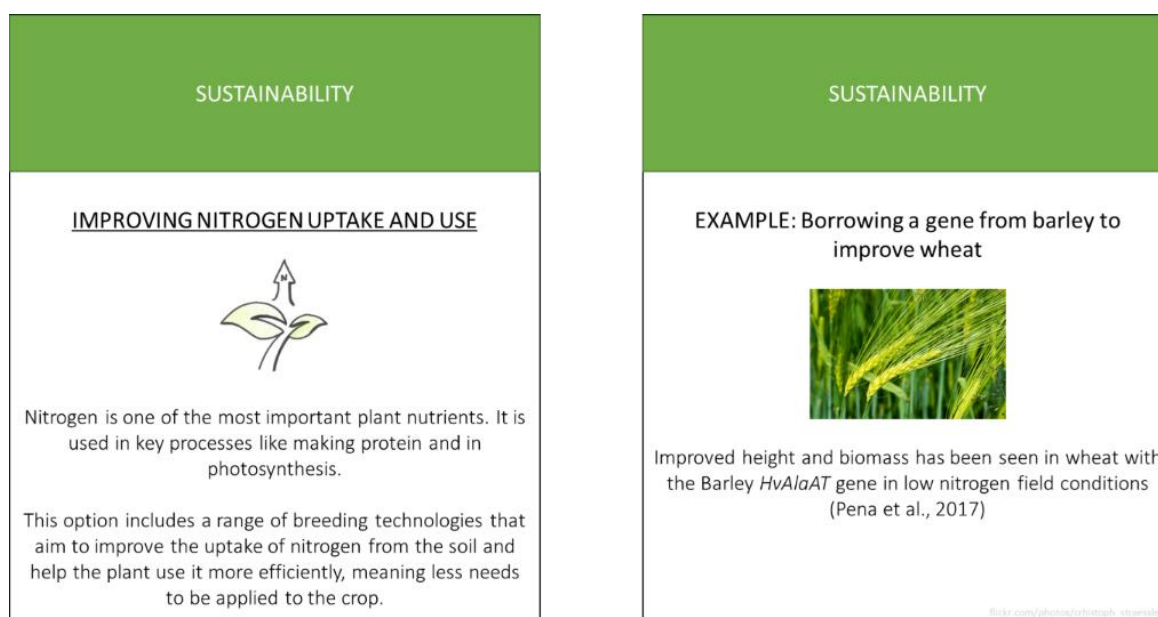


**FIGURE 5: OUTLINE OF METHODOLOGICAL APPROACH TAKEN IN WORK PACKAGE 2**

A topic-specialised researcher (farm-level SS, business JM, consumer AN) was assigned to coordinate workshops. To ensure alignment of methods and data collection researchers mutually assisted each other.

### 2.1.1 OPTIONS PRESENTED IN THE FOCUS GROUPS

To facilitate discussion and to present all the options to participants, the 15 CropBooster-P “options” for crop improvement were introduced on double-sided option cards, an example of which is given in **Figure 6**. These cards featured an indication of the broader aim in which they sat, an explanation of the option itself and a science-based example of this option applied to a real-world crop (primarily drawn from examples in the WP1 toolbox).



**FIGURE 6: EXAMPLE OPTION CARD. FRONT (LEFT) AND BACK (RIGHT)**

In addition to the 15 option cards, a blank card – “Option Card #16” – was created in order to foster discussion about what potential crop improvement strategies could be added to the list developed by WP1 (see **Figure 7**).

**FIGURE 7: OPTION CARD #16 ACTIVITY CARD**

## 2.1.2 FOCUS GROUP PROTOCOL

Focus groups provide a mechanism for both the generation of new ideas and the assessment of potential ideas – they offer insights into the differences of opinion that exist among selected groups of people and generate a large amount of data in a relatively short period of time



(Breen, 2006; Rabiee, 2004). Focus groups were thus considered an appropriate tool to investigate a broad range of opinions on the various crop improvement strategies summarised for this purpose.

A detailed semi-structured focus group protocol was created aimed at face-to-face focus groups. The protocols were pre-tested to guide the researchers through the workshop focus groups and ensure consistency and comparability between the data from each stakeholder group (for the full protocol, see **Annex 1**). The primary questions were:

- What are the biggest challenges for the European agri-food sector over the next 30 years?
- Which CropBooster option is most important?
- Which CropBooster option is least important?
- What might the social, environmental or economic impacts of a particular option be?
- How do these options meet the challenges facing the European agri-food sector?
- What other things should be included in the CropBooster options?

This protocol was piloted by each of the three researchers and by the work package lead; 16 people took part in the in-person pilots, recruited from Lancaster Environment Centre and Wageningen University.

Although conceived and planned as more conventional in-person workshops, the COVID19 lockdown measures in Europe required the protocols to be redesigned for online application. It was determined that virtual focus groups offer comparable data to in-person groups of the same kind (Woodyatt, Finneran, & Stephenson, 2016), although the specific steps to transfer an existing protocol to fully online were not specified in a single source.

To transfer our protocols, while retaining relevance, we adopted the following steps:

1. Identifying a suitable hosting platform and means of recording the focus groups.
2. Determining the best way to adjust the protocol and present Option cards and similar materials in an online environment.
3. Scrutinising to what extent the adjustments in materials amid platform changes the extent to which our main research questions could still be answered.

We detail these steps further below.

*To identify a suitable hosting platform:* Many potential options were considered; it was decided that *Microsoft Teams* would serve as a suitable hosting platform for the virtual discussions as:

- Meetings can be audio and video recorded
- The research team had experience with the software, and the software is fairly easy to use.
- Screensharing made it possible to guide participants through the options cards easily
- Participants can join meetings from an internet browser and are not required to create an account in order to attend the meeting
- It is a widely available platform with fair stability and security options

To facilitate working with different option cards Microsoft Teams was combined with the website *Mural* ([www.mural.co](http://www.mural.co)), which provides a platform for multi-person, interactive whiteboarding. The option cards and the content-free Option Card #16 activity were incorporated into a Mural whiteboard (see **Annex 2**). Multiple versions were created with different card orders to avoid ordering bias.

This allowed us to transfer the existing protocol to an online version with relatively few changes. To do so, some demands for the online tools had to be met, particularly around ease of use; for example, the research team selected a whiteboard and videoconferencing tool that did



not require workshop participants to create an account before using the whiteboard (as this may slow down the workshop and some participants may not have felt comfortable creating an account). In addition, specifically for the whiteboard; the research team also selected Mural as it offers participants the choice of navigating the Mural whiteboard themselves or following along via screensharing – similar to handling offline option cards or sticky notes. To capture the full interaction online, where in contrast to offline focus groups, no physical products or lasting geographic ordering of notes could be created; it was necessary to record both video footage next to the originally planned audio recordings. This adjustment was granted with a revised ethical approval. In addition, specific for the online environment; safe collection and storage of video images (which contain personal data in terms of recognisable faces) became a demand for the platform. Microsoft Teams met these demands as it saves recorded meetings to a secure, encrypted platform called *Stream*.

After addressing these issues, the protocol was re-piloted and produced similar outcomes as the offline protocol. Subsequently, recruitment of potential participants began. As our research population was specified as experts, primarily purposive sampling was applied – targeting people identified by the research team as being expert in the field and belonging to one of the three stakeholder groups outlined earlier.

Some participants provided additional suggestions as co-nomination (“snowball sampling”). Potential participants were approached using an email based on a standardised template (see **Annex 3**) by either the researcher responsible for recruitment of that stakeholder group or by one of our partner organisation representatives. These emails were first targeted at those people who had shown interest in attending the in-person workshops, but later expanded to include a larger pool of potential participants.

### 2.1.3 WORKSHOPS

In total 10 workshops took place between late April and early June 2020 with a total of 35 participants. These involved:

- **16** farm-level participants in five workshops
  - The total number of farmer and farmer organisation representatives approached for these workshops is unable to be determined, as the invitation was sent out through a large agricultural umbrella organisation newsletter.
  - In total 11 farmer/farmer organisation representatives took part in workshops, with 12 initially responding to invitation and one non-attending.
  - In the case of farm-level NGO and policy representatives, 5 took part in the focus groups with 39 approached, 9 responding and 4 were non-attending
- **11** agri-business-level participants in two workshops
  - 30 potential participants were approached, 14 responded, one non-attending
  - 6 plant breeding company representatives
  - 5 agri-business consortium representatives
- **8** consumer experts in three workshops
  - 120 approached, 12 confirmed, four non-attending
  - Experts on consumer issues in agri-food

The workshops were convened by three researchers (SS, JM and AN). All have experience with qualitative data collection. None had any pre-existing relationships with the participants. In the agribusiness workshops, the project was first introduced by a representative of Euroseeds (PJ), who has a professional relationship with several of the participants – after which the representative left before the actual focus group commenced.



The focus groups lasted between seventy and one-hundred twenty minutes, with the average time being one hundred minutes.

A standardized form was used by the researchers to keep notes as they progressed through the focus group protocol.

## 2.1.4 ANALYSIS APPROACH

The video recordings of each focus group were sent to a private GDPR-compliant company for transcription – non-disclosure agreements had been signed in advance. Once the transcripts had been returned, these were checked for errors and anonymised by removing identifying information.

Adopting a *Framework Analysis* approach (Ritchie & Lewis, 2010; Srivastava & Thomson, 2009), an initial coding framework was developed by open coding the transcripts associated with each WP2 task. After these were agreed through consultation with at least one other member of the research group, the transcripts were fully coded and analysed using NVivo qualitative data analysis software for Windows and Mac. An overview of the emergent themes was shared within the wider WP2 consortium for comments. A number of overlapping themes – that is, themes shared by more than one stakeholder group – were identified, as well as others that appear to be more closely aligned with one group rather than others. These are outlined in the results section (section 3).

## 2.2 Survey

### 2.2.1 SURVEY DESIGN, DEVELOPMENT, AND DISTRIBUTION

A survey was designed as an extension to the original WP2 workplan in order to identify which of the options arising from WP1's report were felt to be priorities for the broader constituency of key stakeholders sampled for the workshop, and thereby help to consolidate the findings of the workshops. The survey was primarily quantitative, with some open-ended qualitative questions included to elicit more complex responses to key questions, and focused on understanding which of the fifteen options taken forward from WP1 (following the methods described above in 2.1.1) were felt to be most important. In addition, the survey aimed to identify key crops which participants felt were of importance to the future of European agriculture, to further target the literature synthesis and highlight any important research gaps in relation to these crops.

In line with the workshop, participants were classified to represent three stakeholder groups – farm-level stakeholders; agribusiness level stakeholders; and consumer level stakeholders. In addition, the category of plant scientists was added (a stakeholder group who will be driving Cropboosting technologies). Specific demographic information was gathered from participants relevant to the stakeholder group - for example, farmers were asked questions regarding their farm size and level of agricultural education – in order to allow for comparisons with the target population. The survey was implemented on the Qualtrics online survey software (Qualtrics.com). A summary of the questions asked and their method type is shown below, in **Table 1** (See **Annex 4** for a copy of the full survey in English for further detail regarding the precise demographic questions included for each stakeholder stream). Only one question in the survey forced response before the participant could continue (age, as those under 18 were not allowed to complete the survey). The survey took a median of 10.9 minutes to complete.

**TABLE 1: SURVEY QUESTION SUMMARY**



Question category	Question	Question aim	Question type
<b>Introduction</b>	What is your current age?	Only those 18 years or older were eligible to take part in the survey	Quantitative – fixed choice selection
	Which of the following [stakeholder categories] best describes you?	Separating stakeholders into the relevant stream for demographic questions	Quantitative – fixed choice selection
<b>Ranking</b>	Please rank the following goals [Yield, Nutrition, or Sustainability] in terms of importance to future-proofing European crops	Identifying individual's overarching priority goals	Quantitative - ranking
	Please briefly describe why you have prioritized your chosen goal	Understanding individual's overarching goals	Qualitative – free text
	Please indicate how important you feel [option shown] is for future-proofing European crops	Understanding the importance of WP1 options	Quantitative – Likert style scale  Question repeated for all 15 options; shown in a randomized order to reduce bias
	Are there any other goals which were not included in the above list, but which you feel are important for future-proofing crops?	Identifying priority areas not included in the 15 option cards produced from WP1	Qualitative – free text
<b>Shared demographic questions</b>	Are you contributing to a CropBooster-P focus group in spring 2020?	Identifying individuals giving data in both the survey and workshops	Quantitative – fixed choice selection
	Capacity in which you are filling in this survey	Filling any gaps in stakeholder information which might influence	Qualitative – free text





		data interpretation	
	What is your sex?	Calculating the gender balance of the surveyed population	Quantitative – fixed choice selection
	What is your home postcode?	Identifying the NUTS region relevant to each participant	Qualitative – free text
	Formal education level	Understanding the educational attainment of the surveyed population	Quantitative – fixed choice selection
	Which country do you live in?	Identifying the country in which participants lived (as a back-up for geographical analysis should participants refuse to give postcode data)	Quantitative – fixed choice selection
	Which crops do you feel are most important for the future of European agriculture?	Identifying key crops	Quantitative – fixed choice selection
<b>Farm-level demographic questions</b>	See <b>Annex 4</b>		
<b>Agribusiness-level demographic questions</b>	See <b>Annex 4</b>		
<b>Consumer-level demographic questions</b>	See <b>Annex 4</b>		
<b>Plant scientist-level demographic questions</b>	See <b>Annex 4</b>		
<b>Final section</b>	Any other comments?	Providing a space for further information of relevance to be collected	Qualitative – free text

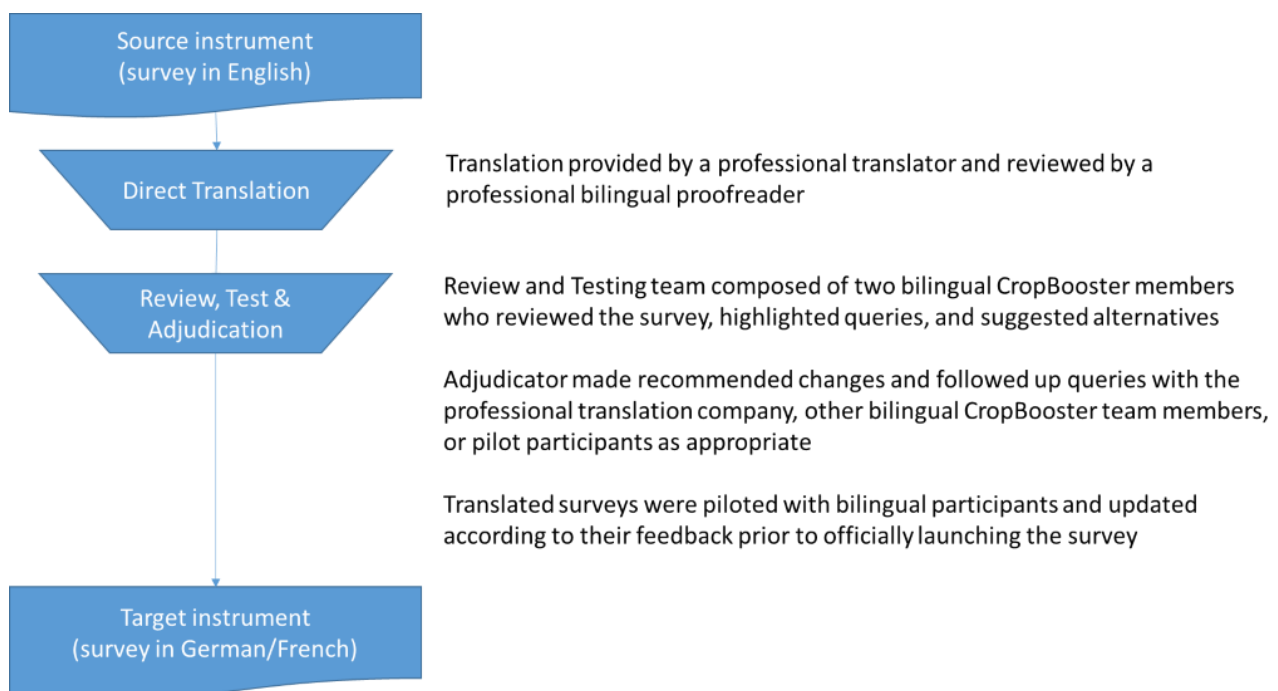




	If you would like to receive information about the results of the project directly, please leave your email address below	Allowing follow-up contact to be maintained and key results to be disseminated to a wide audience	Qualitative – free text  A total of 208 respondents completed this question
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### 2.2.1.1 TRANSLATION PROCESS

In order to enable broad participation, and to reduce English-language only bias, the survey was translated into both German and French, and was therefore made available in all three of the EC's procedural languages. An adapted version of the TRAPD Team Translation method (Harkness & Schoua-Glusberg, 1998; Survey Research Center Institute for Social Research, 2016) was used (see **Figure 8**) to ensure consistency across languages. This method is particularly well-suited to projects such as this, where a number of researchers in the team are bilingual and can provide discipline and context-specific details to refine the generic translation provided by a professional. Survey responses obtained in German and French were translated into English by a professional specialist translator, and proofread by a professional bilingual specialist proofreader, so that results from all three languages could be merged for analysis.



**FIGURE 8: SUMMARY OF THE TEAM TRANSLATION METHOD**

### 2.2.1.2 PILOT SURVEY

The survey was piloted in English prior to translation and piloted in German and French prior to the launch of the survey. A total of 17 participants piloted the English survey, with at least three for each survey stream. Six participants piloted the German and four the French versions, with at least one participant per language per survey stream. The pilot was designed



to identify potential areas of bias, check that the language used was comprehensible, that question instructions were clear, check the survey timing, and flag up any problems with the survey flow. Additional pilot questions at the end of the survey ensured data was collected to further these aims, and the feedback was incorporated into the final draft of the survey. Changes made to the survey following pilot feedback included improved signposting, minor corrections to grammar, and the updating of some terminology.

### 2.2.1.3 SAMPLING AND ETHICAL APPROVAL

Ethical permission was sought and granted through the University of Lancaster in the same application which approved the focus group workshop. As data was not collected from minors or vulnerable individuals, was not of a sensitive nature, was unlikely to cause psychological stress or harm, and was fully anonymized, the survey was deemed low risk.

A snowball sampling strategy approach was used to disseminate the survey in order to maximise the number of participants reached with minimal resource input, with WP2 partners sharing the survey links widely within their professional networks, on social media, and through direct contact with external organizations of relevance (such as the Food Climate Research Network, EAT forum, and IFPRI).

A total of 325 participants took part in the online survey (288 English responses, 23 French responses, and 14 German responses). Seventy-two of these responses were removed from analysis, as the respondents had not completed any data collection question blocks. A further 120 survey results were incomplete but were retained for analysis as the respondents had completed the initial data collection segment regarding goal prioritization – these 120 responses were not used for any analysis apart from the goal prioritization. Five survey responses were deleted as duplicate responses. A total of 204 responses were therefore recorded for participants who had completed all core data collection segments (goal prioritization and option card rankings): 39 for farm-level stakeholders, 27 for agribusiness level stakeholders, 38 for consumer level stakeholders, and 100 for plant scientists. The majority of these participants came from the UK (83), with additional participation from: Belgium (8), Croatia (1), Cyprus (2), Czech Republic (1), Denmark (2), France (15), Germany (11), Greece (1), Italy (31), Luxembourg (1), Netherlands (7), Portugal (2), Romania (1), Spain (10), and a further 12 responses from individuals currently living outside Europe.

## 2.2.2 SURVEY ANALYSIS APPROACH

An agreed analysis framework was used to analyse all survey results across the four stakeholder streams – in these working papers in-depth results are reported for each of the stakeholder groups aligned with a specific task (see **2.1 for farm-level results; 2.2 for agribusiness level results; and 2.3 for consumer level results**).

### 2.2.2.1 OVERVIEW STATISTICS

For each stakeholder group overview statistics were calculated for the total number of responses, responses removed from the analysis due to incompleteness or duplication, and the total number of responses used to analyse: (1) the goal prioritization questions, and (2) the option ranking questions. Basic demographic information, such as the number of respondents from each country represented, spread of age profiles, gender balance, and educational level are also reported, along with stakeholder-group specific demographic characteristics (e.g. farm size for farm-level stakeholders).



#### **2.2.2.2 GOAL PRIORITIZATION**

The percentage of each stakeholder group ranking a given goal (Yield, Nutrition, or Sustainability) as one (top priority), two (medium priority), and three (lowest priority) was calculated, and the most commonly selected top priority goal highlighted. Data from the free text question asking participants to briefly describe why they had prioritized their selected goal was separated into three categories: data from participants choosing Yield as their top priority; data from participants choosing Sustainability as their top priority; and data from participants choosing Nutrition as their top priority. This data was then exported to NVivo 12, and thematically analysed to identify the key issues being raised as explanations for a given goal's priority.

#### **2.2.2.3 OPTION PREFERENCES**

For the 15 Likert-style questions relating to the options identified in the WP1 report, responses were tallied for each of the choices available, and the percentage of participants choosing each statement calculated. The median value for each option was calculated by assigning a value to each Likert-style statement as follows: 'Very important' – 1; 'Important' – 2; 'Neither important nor unimportant' – 3; 'Unimportant' – 4; 'Very unimportant' – 5 (Don't know and blank responses were excluded from the median analysis). The use of a median value here is particularly useful as it allows a way of quantitatively comparing across a number of Likert-style questions which are not designed to be intrinsically linked (Boone & Boone, 2012) (e.g. the options are not presented as necessarily being mutually exclusive, due to their potential importance both individually and in combination), but which have a comparative relationship due to their intrinsic nature. In this instance, calculating median values for each option is particularly valuable, as it allows identification of priority options for each stakeholder group. Differences between option median results were then reviewed based on: top goal priority, gender, and other stakeholder group-specific demographic questions as appropriate, in order to identify patterns and trends.

#### **2.2.2.4 MOST IMPORTANT CROPS**

Survey respondents were asked to choose up to five crops which they felt were most important for the future of European agriculture. The most frequently selected crops were identified for each stakeholder category, and differences in option preference based on crop preference were reviewed for the most frequently selected crops in each stakeholder group.

#### **2.2.2.5 OPTION CARD 16**

After reviewing the 15 pre-defined options identified in WP1, survey respondents were asked "Are there any other goals which were not included in the above list, but which you feel are important for future-proofing crops?" This question was included in order to compare with the Option Card 16 activity which focus groups took part in, described above. The free text data collected for this question was thematically analysed for each stakeholder group to identify recurring themes and key options which respondents felt were missing from the survey.

#### **2.2.2.6 ADDITIONAL STAKEHOLDER-SPECIFIC ANALYSIS AND SYNTHESIS**

Additional analysis of relevance to each stakeholder group was carried out as needed, based on the group-specific demographic questions used, and is described in the relevant chapters of this report. A synthesis of the overarching themes and results arising provides key conclusions for each stakeholder group, identifies the priority options to be taken forward in the next stages of the project, and links results from the survey with those from the stakeholder workshops.



## 3 INTRODUCTION TO DELIVERABLE 2.3

### 3.1 Aims

In this working paper, we share initial findings from Work Package 2 (WP2), which aims to assess the potential economic, social and environmental impacts of the CropBooster options for improving yields, sustainability and nutrition arising from Work Package (WP1) of CropBooster-P.

This paper specifically focuses on assessing the consumer-level impacts associated with adopting the breeding options identified in WP1. We have taken a mixed-method stakeholder-led approach to exploring the cropboosting priorities and potential impacts of adopting the cropboosting options in Europe. Here, we report on the findings from a series of online focus groups and an online survey focusing on contributions from consumer-level stakeholders.

The expert stakeholders engaged with in the development of this working paper were consumer representatives in Western Europe working on the issues of agriculture, food security, nutrition, health and environment.

## 4 CONSUMER-LEVEL FOCUS GROUP RESULTS

Three online focus groups were held in June 2020, with eight participants representing five EU countries (Belgium, France, Italy, Sweden, the Republic of Ireland and the UK). Of these eight participants, six were female and two were male. The online focus groups ranged in size from two to three participants. The online focus groups lasted between 1 hour and 10 minutes and 2 hours. The main themes arising from these workshop discussions are described below.

### 4.1 Challenges for the European agri-food sector

Participants were invited to describe what they perceive as the most significant challenges for the European agri-food sector in the near future. It was noted that many of the challenges listed below are interlinked.

#### 4.1.1 FOOD AND NUTRITIONAL SECURITY IN THE ANTHROPOCENE

The biggest challenges consumer experts perceived for Europe's food and agricultural sector are its exposure to climate change and meeting food and nutritional requirements for a growing population. Most consumer experts felt that drought was a major issue in Europe which adversely impacts food production.

*"I work basically in emergencies and I see how much like droughts and other disasters have an impact on agriculture production." – Consumer #1*

*"... are issues around climate change and making sure that future agricultural production practices are compatible with the concerns that climate change brings." – Consumer #5*



Conversation on the issues also highlighted the challenges that an increasing population imposes on food production.

*"The biggest issues are the growing population and producing enough food sustainably for an increasing population that's present. And getting the balance right in the types of food being produced that meet nutritional requirements for health as well as meeting requirements for sustainability" – Consumer #4*

#### **4.1.2 GOVERNANCE AND THE REGULATION OF (BIO)TECHNOLOGY**

Another issue mentioned was the lack of clear-cut regulation around new plant breeding technologies. Consumer experts highlighted that the regulation of (bio)technology was outdated requiring amendments and updates to current legal frameworks to foster innovation and transform the food system.

*"...would be the legal framework for technology adoption, let's say GMO or gene editing. So far, the legislation framework is still quite unclear, it would require some updates and amendments." – Consumer #6*

*"The current legal framework in regulating GMO and others are still quite outdated in a way. So, if they really want to make a change in the food system and the agricultural system, I think they should consider revising the legal framework first ..." – Consumer #8*

#### **4.1.3 CONSUMER BEHAVIOUR AND ACCEPTANCE OF NEW PLANT BREEDING TECHNOLOGIES**

A common observation was the acceptability of new plant breeding options and technology for crop improvement. The groups felt that some breeding strategies may be viewed as dangerous like genetically modified crops.

*"...you think a range of breeding technologies... you think yes, that sounds really good. And when you dig deeper it's a genetic modification, there's going to be a lot of resistance from a consumer perspective to GM crops." – Consumer #4*

*"Maybe Europeans will accept GMO, but today it's not the case." – Consumer #3*

Most participants felt that in-order for consumers to have a positive outlook of new plant breeding strategies there is a need to communicate the impacts of these technologies and provide the option for consumers to participate and choose what is acceptable.



*"if we tell consumers something about water use, they probably will notice it or it would feel more relevant because, for example, in [country] the governments say you cannot use a water spray in your garden because we have a shortage, then to communicate to them that this technology is specific to reduce water use to make it more efficient, those would be technologies that would have a higher chance to get acceptance in the society." – Consumer #6*

## **4.2 Appraisal of CropBooster options**

In this sub-section several key themes that emerged during the discussions vis-à-vis the 15 cropbooster options are detailed.

### **4.2.1 UNCERTAINTY IN SELECTING OPTIONS AND THE KNOWLEDGE GAP**

Consumer group experts expressed that consumers were uncertain regarding the scope, impact and the risks and benefits associated with the options. For instance, the stakeholders weren't sure about

i) the crops these options were intended to be altered and

*"I think it all depends a lot on which type of crops that these interventions are possible for and, if it's a problem for these crops, we don't know a lot about it." – Consumer #4*

ii) geographical scope of the options

*"I can imagine that has implications in a broader sense, I just don't know enough to say whether or not that would have any resonance in Europe in a significant way." – Consumer #5 (In relation to improving salt stress)*

Additionally, they also expressed that there is a knowledge gap between the professional communities which needs to be bridged to be able to critically think about risks and benefits of these cropboosting options.

*"... what you should be doing going out is telling the world these are the challenges you face, we face. What do you think about how we could be approaching what the pros and cons are and I think some way of making those issues more transparent to all parts of the community would help with being able to prioritize, because otherwise, I think that one's coming in with ignorance, because we can challenge and I think quite often we as a professional community don't offer means for people to engage in these things and then are sometimes surprised with people's ability to do so." – Consumer #7*



## 4.2.2 POTENTIAL TRADEOFFS

Consumer experts identified the following cropboosting options 'Increasing the size of harvestable parts', 'Increase protein content and quality' and 'Decreasing negative and toxic compounds' as problematic. Most consumer experts felt that increasing size of harvestable parts could lead to a decrease in quality, nutrition and taste while increasing protein content might increase certain disease types. Consumers also suggested that protein intake in Europe was already high and wasn't important.

*"I'm not excited about increasing the size of harvestable parts, and the reason is if increasing the size has negative impacts on quality or taste profile" – Consumer #5*

*"... increasing the protein content might also increase a certain type of, let's call it, disease in population such as intolerance to gluten" – Consumer #1*

Furthermore, consumers also suggested that decreasing negative and toxic compounds can have consequences on the natural cycle of life of these plants and in relation to its environment.

*"... the negative and toxic compounds that didn't sit completely comfortably with me and in this set because on the one hand, because if you are seeing it as empty, or you are blocking the uptake of other nutrients. But you could also have things that are just toxic in their own right, rather that they're impinging on nutrient uptake." – Consumer #4*

## 4.2.3 CONSUMER PERCEPTION OF THE POTENTIAL IMPACTS, RISKS AND BENEFITS

The options listed in the Table 2 were referenced the most during the focus groups as the "most important" options for the European agriculture and food sector. Table 1 provides a map of the impacts perceived by consumer. Four options fell under the strategy for improving sustainability and two under improving nutrition. Consumers ascribed options for 'Improving nitrogen uptake' and use and 'Improving phosphorus use efficiency' to the efficiency of fertilizer use, soil quality and reduced production costs.

*"My thinking is more along the line of- when it comes to phosphorous and nitrogen, it will be like more related to the use of the efficient use of fertilizers or maybe also reducing the use of fertilizers, which might have like a big impact not only on the cost of production for farmers, as well as, the environmental implications of crop production." - #Consumer 1*





While the other two sustainability options 'Improving plant water use' and 'Improving heat stress tolerance' was attributed to efficient use of resources and as climate resilient development.

*"I am also drawn to improving plant water use and heat stress tolerance because of the issue of global climate change, I can imagine that those would be ones that even most consumers would have a sense that this could be a problem if they thought about or if they think about climate change in any way." - #Consumer #5*

Additionally, consumers agreed that 'Producing healthy omega-3' and 'Improving antioxidant content' would have both a market (e.g. Demand and price premium) and health benefit (e.g. Diets and nutrition).

*"... in terms of the importance of the healthy balance of a healthy oils and their importance in the context of health in the diet and it's an important strategy to follow... in terms of us and having a sustainable perspective, we could say, it would be more sustainable to produce a plant omega three than to produce a fish was omega three." – Consumer #4*

**TABLE 2: PERCEIVED BENEFITS OF MOST IMPORTANT CROPBOSTING OPTIONS**

<i>Options</i>	<i>Social Impact</i>	<i>Economic Impact</i>	<i>Environmental Impact</i>
<i>Improving nitrogen uptake and use</i>			
<i>Improving phosphorus use efficiency</i>			
<i>Improving plant water use</i>			
<i>Improving heat stress tolerance</i>			
<i>Producing health omega 3</i>			
<i>Improving antioxidant content</i>			

Furthermore, all fifteen cropboosting options were discussed by at least one stakeholder certain options were thought to be of relevance to specific European regions, or local contexts (e.g. salt stress being of importance to parts of the France, Spain and Italy), while others were considered to vary in importance. For instance, they felt that 'Improving the digestibility of biomass' was important as feed for animals and improving energy efficiency of biofuels but not for human food and nutritional security.





## 4.3 Additional themes

### 4.3.1 MANAGING FOOD SYSTEM COMPLEXITY

Consumer experts highlighted that there was the lack of global governance mechanisms in place to ensure robustness and resilience of the currently complex food system during emergencies such as the 2020 COVID19 pandemic.

*"I would guess it's about knowing one's place in the world in terms of what range of the food supply they should be responsible for. And I think the recent events where we've had the pandemic have sort of highlighted some of those challenges. So, again, how to sort of feed into a complex system like this, and things around the governance and support that's available." – Consumer #7*

### 4.3.2 FOSTERING INNOVATION

One issue highlighted by consumer experts was concerning sustainable innovation by steering consumer and consumption behaviour in tandem with technological innovation.

*"...the regulation around both the technological innovations, but also a steering consumption patterns in a more sustainable direction I think are really difficult, but important aspects..." – Consumer #6*

*"...the adaption of technology but also in consumer behaviour or consumptions patterns is a key issue." – Consumer #8*

### 4.3.3 ALTERNATIVE STRATEGIES FOR FOOD AND NUTRITIONAL SECURITY

Consumers suggested alternatives as a natural solution to improving food and nutrition security. They emphasized sustainable/ organic farming and changing diets.

*"... can also be algae and seaweed... as an alternative protein are really useful today." – Consumer #1*

*"I think that urban agriculture is becoming very important right now for security in European cities, and there's a huge movement in that. I think the aspects of urban agriculture in adapting crops to would be interesting." – Consumer #2*

## 4.4 Option Card #16 activity

After participants discussed all fifteen option cards, they were given a chance to highlight possible options that they felt were important for future proofing Europe's through an activity called "Option Card 16". Participants during this activity mentioned several possible options, however they found it difficult to build consensus around one strategy as the most important. Presented here is a summary of the key issues raised in these discussions – in the interest of brevity and clarity, only those issues which were raised multiple times and are not discussed in the general themes above are shown in Figure 9.



**FIGURE 9: CONSUMER RESPONSE WORKSHOP: KEY THEMES IN OPTION CARD 16 (DARKER BLUE CORRESPONDS TO A THEME BEING MORE FREQUENTLY MENTIONED)**

## 5 CONSUMER-LEVEL SURVEY RESULTS

A total of 37 consumer experts completed the survey; with an additional 1 who did not complete the survey, but did complete the first data-collection section relating to overarching goals for future-proofing European crops; to retain as much data as possible, these results are presented in the section of this report relating to goal prioritisation. No responses were removed from all analysis. Most of the results refer to the 37 complete responses, though the exact number varies where participants opted not to complete a particular question. No consumer-level responses were duplicates.

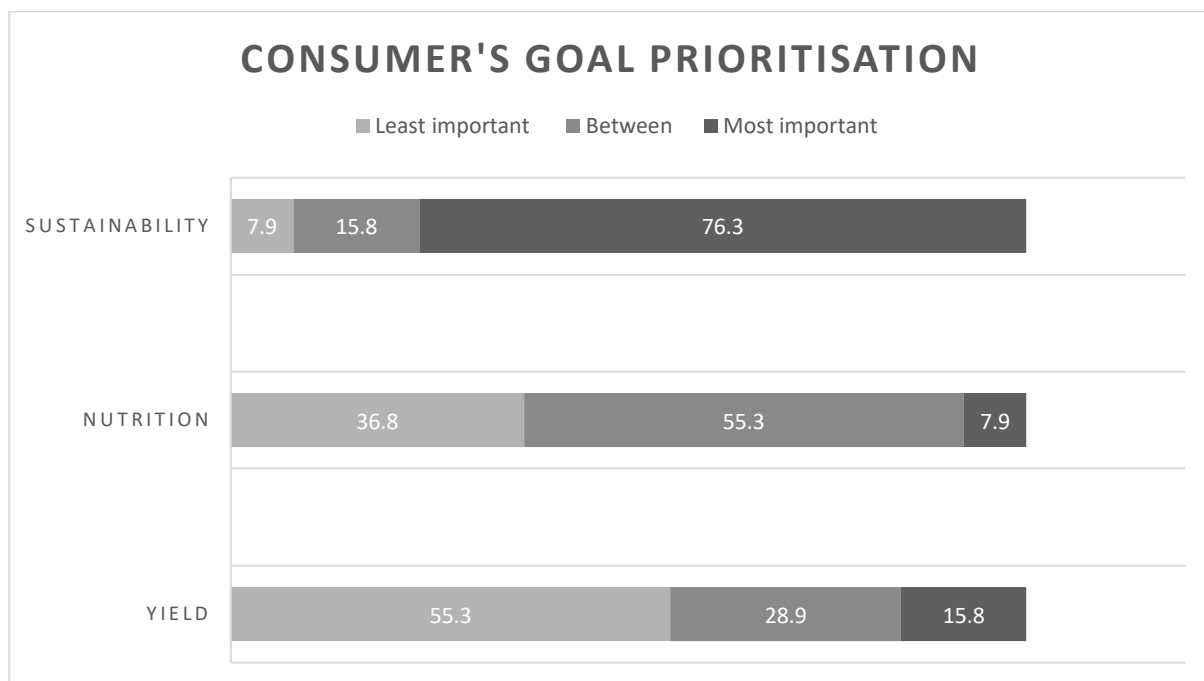
Half of respondents were between 25 and 49 years of age (19 individuals, 50%), with the rest falling between 50 – 64 (7 individuals, 18.42%) and 18 – 24 (12 individuals 31.58%). More than half of respondents (20 individuals, 55.56%) were from the UK, followed by 4 individuals (11.1%) from Italy, 3 individuals (8.3%) Germany, 2 individuals (5.5%) from Cyprus and 1 individual (2.8%) from Belgium, Croatia, and Spain. Additionally, about 3 individuals (8.3%) of



the respondent did not disclose where they were from. The sample was well gender-balanced, with 20 female, 14 male respondents and four who either indicated they preferred not to say, or not answering this question at all. Most participants had at least a post-secondary education, beside 6 individuals (17.1%) having a Bachelor's, 12 individuals (34.3%) with a master's or equivalent degree, 8 individuals (22.9%) having a Doctoral or equivalent degree and three individuals did not answer this question.

## 5.1 Goal prioritisation

When asked to rank Yield, Nutrition, and Sustainability in terms of importance to future-proofing European crops, a large majority of consumers (76.3%) selected Sustainability as the most important goal, and Yield as the least important goal (55.3%) (see Figure 10).



**FIGURE 10: CONSUMER'S GOAL PRIORITISATION**

Participants were asked to describe why they had prioritised their chosen goal of Yield, Nutrition, or Sustainability. Nearly all respondents (22 out of the 38) felt that improving sustainability underpins the other two goals. Most participants also emphasized the need to lower the impact of food production and supply chain system on the environment. The importance of climate change and its impacts on the food system was mentioned by eight often in reference to the need to adapt to the impacts of extreme weather and temperature rise and its implication for food and nutritional security in the long term. Concerns surrounding food security and the need to produce enough food for everyone while reducing input use and maintaining resilience were often raised – conversely, a number of participants felt that Europe already produces enough food and used this to explain why they had not selected yield as the most important goal. Several participants also stated that they felt plant breeding was not the best way to achieve one or more of the goals (e.g. nutrition could be better handled through dietary change; yield through sustainable land management and reducing food waste and loss, etc.)

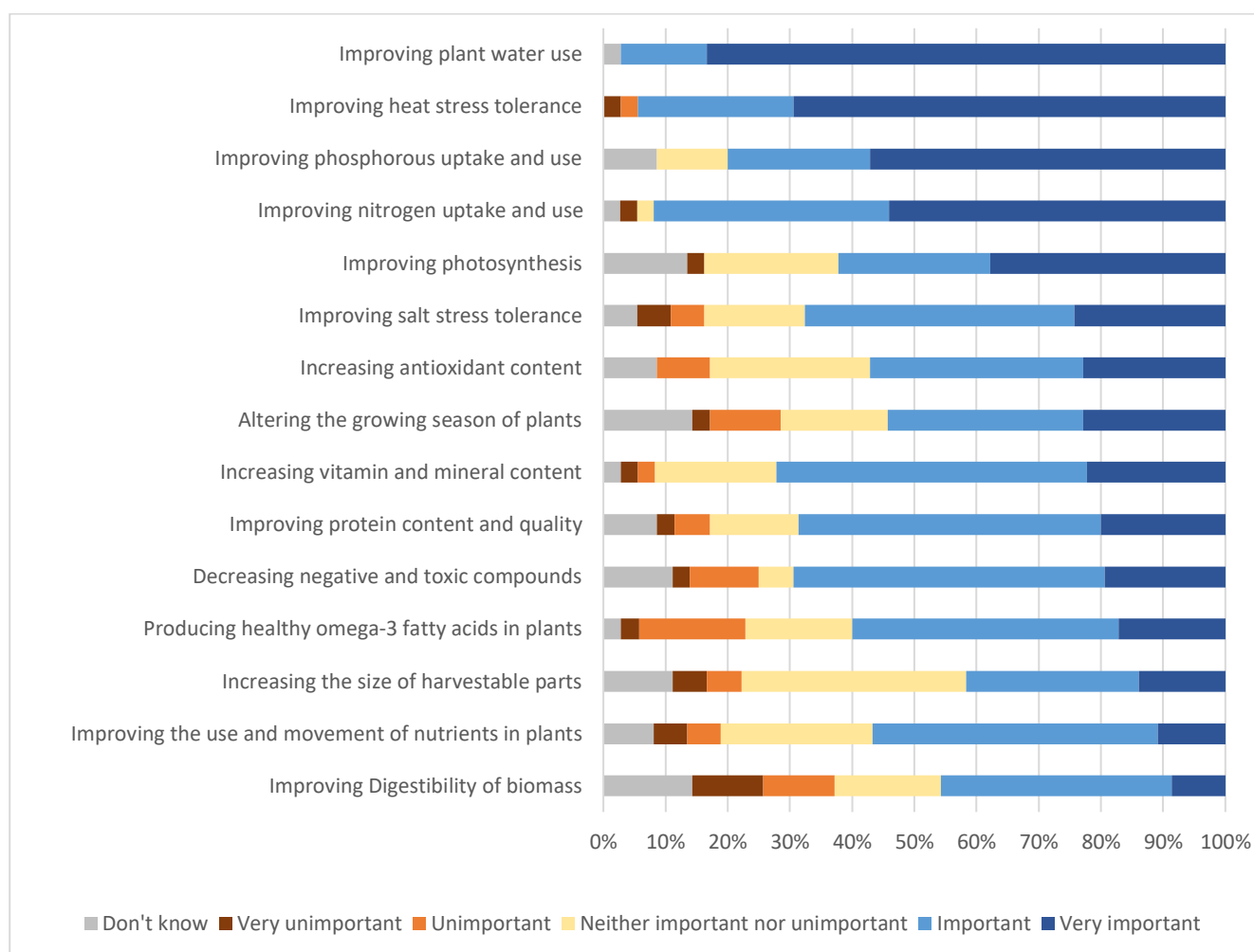


*"I think that we should maximize the sustainability of our crops so that require less space and are better prepared to face adverse conditions (3). Once this is accomplished, we can fully benefit from the increase of their quality (2). To simply produce more amount (1) may not be beneficial if plants prematurely die or their quality is still poor." – Survey participant (selected sustainability as top priority)*

## 5.2 Option preferences

In the survey, respondents were asked how important the fifteen crop improvement options were identified by WP1. The most highly ranked options were 'Improving plant water use', 'Improving heat stress tolerance', 'Improving Phosphorous uptake and use' and 'Improving Nitrogen uptake and use' (each with a median response of 1, meaning 'Very important'). The majority of options had a median of 2 (meaning 'Important'), and three options, 'Improving digestibility of biomass', 'Altering growing season of plants' and 'Increasing the size of harvestable parts' having a median of 3 (meaning 'Neither important nor unimportant'). The full list of options ordered by the number of 'Very important' responses can be seen in Figure 11.

Additionally, some variation in option preference is visible by goal prioritisation grouping – for example, those who felt Yield was the most important goal also indicated that the option- "Improving photosynthesis" – was highly variable and did not show clear patterns goal priority being consistently in line with option preferences. This may be due, in part, to the fact that many other ways of achieving a given goal exist beyond the five options presented in the survey, and these may be the mechanisms preferred by a respondent. However, given the low numbers of individuals choosing Nutrition (3 votes) and Yield (5 votes) as the most important goals, it is difficult to speculate further on the minor variation seen here. Little variation in option preference was seen by sex, with 'Improving plant water use', 'Improving heat stress tolerance', 'Improving Phosphorous uptake and use' and 'Improving Nitrogen uptake and use' having medians of 1 (Very important) in both male and female groups. Male respondents' selections for 'Improving photosynthesis' also yielded medians of 1, while for females these two options had medians of 2.



**FIGURE 11: CONSUMER-LEVEL STAKEHOLDER OPTION PREFERENCES (AS A PERCENT OF COMPLETED RESPONSES)**

## 5.3 Most important crops

When asked 'Which crops do you feel are most important for the future of European agriculture?' (the question allowed for up to five crops to be selected by each participant) the most highly ranked crops were: wheat (21 votes), followed by oats, potatoes, soybean with 13 votes (see Table 3).

**TABLE 3: CROPS SELECTED AS MOST IMPORTANT FOR EUROPE BY CONSUMER**

Which crops do you feel are most important for the future of European agriculture?	
Wheat	21
Oats-	13
Potatoes	13
Soya	13



Barley	11
Grain maize and corn-cob mix	10
Rice	10
Tomatoes	8
Carrots	7
Onions	7
Olives	5
Rape and turnip rape seeds	5
Grape	4
Rye and maslin	4
Sugar beet	4
Sunflower seeds	4
Sorghum	2
Spelt	1
Triticale	1
Others/N.A.	34

Differences in option preference were assessed for the top four crops identified as most important for the future of European agriculture (wheat, oats, potato, and soybean). Little variation is seen in option importance – the most important options for the full consumer-level category remains the most important options for each crop (see Table 4). However, some options may be considered of higher or lower importance to those prioritising specific crops, as in the case of those selecting soybean as important crops also selected 'Improving photosynthesis' as a very important option (median of 1).

**TABLE 4: OPTION PREFERENCES BY CROP PRIORITY\***

\***DARK BLUE INDICATES A MEDIAN SCORE OF 1 (VERY IMPORTANT), LIGHT BLUE A SCORE OF 2 (IMPORTANT) AND YELLOW A SCORE OF 3 (NEITHER IMPORTANT NOR UNIMPORTANT) – FRACTIONS ROUNDED UP FOR COLOUR CODING PURPOSES**

	Options	Consumer Median	Wheat	Oats	Potatoes	Soybean
Sustainability	Improving plant water use	1	1	1	1	1
	Improving heat stress tolerance	1	1	1	1	1
	Improving Nitrogen uptake and use	1	1	1.5	1	1
	Improving Phosphorous uptake and use	1	1	1	1	1



	Improving salt stress tolerance	2	2	2	2	1.5
Yield	Improving photosynthesis	2	2	2	2	1
	Improving digestibility of biomass	3	2	3	2.5	2
	Improving the use and movement of nutrients within the plant	2	2	2	2	2
	Altering growing season of plants	3	2	2	2	2
	Increasing the size of harvestable parts	3	2	3	2	2
Nutrition	Increasing protein content and quality	2	2	2	2	2
	Increasing vitamin and mineral content	2	2	2	2	2
	Increasing antioxidant content	2	2	2	2	3
	Decreasing negative and toxic compounds	2	2	2	2	2
	Producing healthy omega-3 fatty acids in oilseeds	2	2	2.5	2	2

## 5.4 Option card #16 survey results





**FIGURE 12: CONSUMER SURVEY: OPTION CARD 16 KEY THEMES (DARKER BLUE CORRESPONDS TO A THEME BEING MORE FREQUENTLY MENTIONED)**

Respondents raised a number of important issues which they felt were missing from the options presented – the four most frequently cited options are shown in Figure 12. Consumer felt new plant breeding option and techniques that use less resources such as greenhouses, hydroponics, permaculture, pasture-fed livestock, organic farming while maintaining crop plant species diversity, encouraging natural pest control were most needed. Additionally, they emphasized that new plant breeding technologies must focus on increasing resistance to pest, climate perturbations and preserve nutritional value while communicating the impacts of these technologies to the public.

For biodiversity conservation, consumers emphasized the need to protect crop species and diversity and the biome. Additionally, consumers also felt there is a need to change how we consume by encourage local buying and reducing European food imports, which may mean changing peoples' expectations of what they can buy and eat. It was also mentioned that by localizing supply chain we encourage local buying and reduce European food imports.

## 6 CONCLUSIONS

- The most highly ranked options in terms of importance for the consumer stakeholder group were:
  - 'Improving plant water use',
  - 'Improving heat stress tolerance',
  - 'Improving Nitrogen uptake and use', 'and
  - 'Improving Phosphorous uptake and use' – each with a median of 1 (equivalent to 'Very important').
- All four selected options fall under the category of Sustainability, with nearly 75% of respondents choosing Sustainability as the most important of the three goals.
- The crops most frequently cited as being most important for the future of European agriculture were wheat, oats, potato, and soybean. Little variation was seen in option importance by crop priority.
- Several similar key themes emerged from the workshop and survey discussions such as the importance of the climate change and population increase, consumer behaviour, and acceptance of new plant breeding technologies and alternative crop improvement strategies.
- The importance of preparing European food systems to cope with climate change and population increase through a combination of reducing the use of inputs, and sustainable land, farm, and changing consumer behaviour vis-à-vis consumption and food choice were highlighted throughout.
- Trade-offs with strategies such as 'Increasing the size of harvestable parts', 'Increase protein content and quality' and 'Decreasing negative and toxic compounds' were highlighted and the need to avoid them was an important issue raised.





## 7 CONTRIBUTORS TO THE WP2 DELIVERABLES

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## 8 ANNEXES





### **CropBooster-P**

#### **Annex 1: Workshop Protocol**



	<b>Online workshop outline</b>	<p>The purpose of these workshops is to understand the potential economic, social and environmental impacts of CropBooster-P crop improvement options, which fall under three headings: yield, nutrition and sustainability.</p> <p>The workshops are an opportunity for stakeholders – farmers, NGOs, breeders, agri-food industry and others – to discuss issues around these options and feed into a roadmap for the future.</p> <p>We will be showing stakeholders 15 crop improvement options identified by CropBooster scientists as possible and desirable for future plant breeding efforts. These are:</p> <div style="margin-left: 40px;"> <p><i>Yield</i> { <i>Improving photosynthesis</i> <i>Increasing the size of harvestable parts</i> <i>Improving the use and movement of nutrients in the plant</i> <i>Increasing the growing season of the plant</i> <i>Improving digestibility of biomass</i></p> <p><i>Nutrition</i> { <i>Increasing vitamin and mineral content</i> <i>Increasing protein content and quality</i> <i>Decreasing negative and toxic compounds</i> <i>Increasing antioxidant content</i> <i>Increasing omega – 3 fatty acid content</i></p> <p><i>Sustainability</i> { <i>Improving nitrogen uptake and use</i> <i>Improving plant water use</i> <i>Improving phosphorous uptake and use</i> <i>Improving heat stress tolerance</i> <i>Improving salt stress tolerance</i></p> </div> <p>The workshops will also help us determine which options will be explored in a systematic literature review later.</p>
	<b>Main questions</b>	<ol style="list-style-type: none"> <li>1. <i>What are the CropBooster option priorities for key stakeholder groups?</i></li> <li>2. <i>What are the potential social, economic and environmental impacts of the CropBooster options?</i></li> <li>3. <i>What important issues do the CropBooster options leave out?</i></li> </ol>



	<b>Details</b>	<p>There will be up to 15 online workshops:</p> <ol style="list-style-type: none"> <li>1. 2.1A: <i>farmers (X3)</i></li> <li>2. 2.1B: <i>regulators, policy makers and NGOs (X3)</i></li> <li>3. 2.2A: <i>plant breeders (X3)</i></li> <li>4. 2.2B: <i>agri-food supply chain (X3)</i></li> <li>5. 2.3A: <i>consumer interest organisations (X3)</i></li> </ol> <p>We are aiming for 4-5 participants at each online workshop, which will be moderated by one of three postdoctoral researchers in charge of recruiting for and hosting the event</p> <p>Participants will cycle through three “virtual stations” on <i>Mural</i> before moving onto a final activity, Option Card #16. Moderators must begin the workshops at a different station every time.</p> <p>The stations will represent either yield, nutrition or sustainability. At each station there will be four or five ‘option cards’ (see below) that describe one of the options for that station:</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p>To facilitate this process, six <i>Mural</i> whiteboards have been created, each with different station and option card ordering. This has been done to reduce any <i>order bias</i> and the effects of tiredness as participants move through the session.</p>
	<b>Materials</b>	<p>Make sure:</p>



		<ul style="list-style-type: none"> <li>• You have sent the PIS to all participants by email at least 24 hours in advance of the online workshop; preferable attached to the invitation email.</li> <li>• You have created the event as a Teams meeting (this is mandatory for video recording)</li> <li>• You have created a back-up meeting in Webex</li> <li>• You have a draft of an email to all participants with the back up Webex link prepared and ready to be sent in case of any issues with Teams</li> <li>• You have sent a follow-up email that details the <b>time</b>, Teams <b>link</b> and <b>agenda</b> for the meeting</li> <li>• Make sure:             <ul style="list-style-type: none"> <li>○ You have <b>screen capture software</b> set up or a <b>voice recorder to record audio via laptop/tablet speakers (this is back up in case Teams doesn't record properly)</b></li> <li>○ You know how to use the voice recorder</li> <li>○ You have checked that the voice recorders work (<b>battery</b>)</li> <li>○ You have provided participants with a link to consent form</li> <li>○ You have checked in advance that all participants have filled in the online consent form                 <ul style="list-style-type: none"> <li>▪ Have links to consent forms ready in case anyone has not yet done it/wants to remind themselves of what was in it</li> </ul> </li> <li>○ You have links to option card materials and are comfortable using them</li> <li>○ You have a <b>note pad</b></li> <li>○ <b>You have the printed/written out notetaking sheet</b></li> <li>○ <b>You have two pens</b></li> <li>○ List of (expected) attendees</li> </ul> </li> <li>• Partner organisation is either A. attending to give a short presentation, B. sending a prepared video which you have ready, or C. not attending and you have added a thank you slide to the presentation</li> <li>• You have a spare computer already switched on, with the links for the Teams and Webex calls ready to activate if need be</li> <li>• You have an LAN to connect to the internet directly</li> <li>• You have a set of headphones (preferably with a microphone) - unless you are using the dictaphone as a back up, in which case check that your audio quality is acceptable</li> </ul>
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		<ul style="list-style-type: none"> <li>You know who is attending and who is missing</li> </ul>
Allow ~30 minutes for people to arrive and mingle	<b>Before starting</b>	<p>Ensure that you:</p> <ul style="list-style-type: none"> <li>Greet people as they arrive and make them feel welcome</li> <li>Chat with them, try not to leave anyone out</li> <li>You explain to participants that you will be recording the event</li> <li>Check everyone's microphone and video connections individually</li> <li>We have a designated backup moderator ready to help out</li> <li>Send out a link to consent forms in advance of the meeting</li> </ul>
1-15	<b>Welcome presentation</b>	<ul style="list-style-type: none"> <li>Hosting partner can give a quick introduction (1-2 minutes) or provide a video</li> <li>Explain project <ul style="list-style-type: none"> <li>Focussing on three areas of crop improvement: yield, nutrition and sustainability</li> </ul> </li> <li>Explain ground rules <ul style="list-style-type: none"> <li>There are no wrong answers</li> <li>We're video/audio recording so we don't miss anything but your responses will be kept anonymous</li> <li>Online meetings aren't as fluid as in-person meetings, so please be patient with each other and I'll try to make sure everyone gets a turn speaking.</li> <li>Glitches usually resolve quickly – here's how we will deal with them</li> <li>If you have issues with audio during the call, please use the chat function to alert the moderator</li> <li>If the moderator drops out of the call and does not return within 5 minutes, please: 1) check your email to see if we have sent you anything and if not, 2) contact the emergency moderator (put the emergency moderator's email in the chat)</li> </ul> </li> </ul> <p><b>[REMINDEVERYONE THAT THEY NEED TO SIGN THE CONSENT FORM IF THEY HAVEN'T DONE SO]</b></p>



15-20	<b>Introduction (only at option station #1)</b>	<p><b>JM: YIELD STATION AN: NUTRITION SS: SUSTAINABILITY</b></p> <p><b>[START TEAMS RECORDING AND VOICE RECORDER/SCREEN CAPTURE SOFTWARE]</b></p> <p>I would like each person to briefly introduce themselves:</p> <ol style="list-style-type: none"> <li>1. Can you tell us your first name and a little about your organisation?</li> </ol> <p><b>[MAKE A NOTE OF PEOPLE'S NAMES – YOU'LL NEED THEM]</b></p>
20-25	<b>Warm-up question</b>	<p>OK, now I would like to ask about what you think about the challenges for European food and agriculture:</p> <ol style="list-style-type: none"> <li>2. What do you think the biggest challenges will be over the next 30 years?</li> </ol>
25-45	<b>Appraisal of Cropbooster options and impact assessment</b>	<p><b>[PROVIDE A LINK (ABOVE) TO THE APPROPRIATE MURAL START – EXPLAIN THAT YOU WILL ALSO SHARE YOUR SCREEN. ENSURE EVERYONE CAN SEE OPTION CARDS]</b></p> <p>Here are some targets for crop improvement that our team have highlighted as important. We'll go over them together but it might be useful to make a note of those you find interesting.</p> <p><b>[ALLOW EVERYONE TO READ THE CARDS]</b></p> <p><b>[ON 'SUMMARY PAGE' ASK PARTICIPANTS TO MAKE A NOTE OF WHICH OPTION THEY THINK IS MOST AND WHICH LEAST IMPORTANT]</b></p> <ol style="list-style-type: none"> <li>3. Which option strikes you as the most important? Which option is least important?</li> </ol> <p><b>PROMPT:</b></p>



		<p><b>WHY IS [OPTION] THE MOST IMPORTANT/UNIMPORTANT?</b></p> <p><b>DID ANYONE ELSE HAVE THAT OPTION AS THE MOST/LEAST IMPORTANT?</b></p> <p><b>NOBODY HAS SAID [OPTION]. WHY?</b></p> <p>Now, thinking about the potential impacts of these options:</p> <p>4. What would be the impact of [option] be?</p> <p><b>PROBE:</b></p> <p><b>WHY DO YOU THINK THAT?</b></p> <p><b>WHAT ABOUT [SOCIAL/ECOMOMIC/ENVIRONMENTAL] IMPACTS?</b></p> <p><b>PROMPT:</b></p> <p><b>DOES ANYONE DISAGREE ABOUT THE IMPACT OF THAT OPTION</b></p> <p><b>WHAT ELSE WOULD HAVE TO HAPPEN FOR [OPTION] TO HAVE IMPACT?</b></p>
45-50	<b>Insurance question</b>	<p>Lastly, I would like to know:</p> <p>5. How do these options meet the challenges you outlined earlier?</p>
50-80	<b>Option station #2</b>	<p><b>[MOVE GROUP TO NEXT OPTION CATEGORY]</b></p>
80-110	<b>Option station #3</b>	<p><b>[MOVE GROUP TO NEXT OPTION CATEGORY]</b></p>





110 - 125	<b>Option Card #16 activity</b>	<p>Now you have an opportunity to tell us what <b>else</b> should be included in these options for future-proofing European agriculture.</p> <p><b>[SCROLL TO OPTION CARD #16 AND ASK THEM TO DISCUSS WHAT SHOULD BE ON IT]</b></p> <p><b>PROMPT:</b></p> <p><b>CAN WE AGREE ON WHAT OPTION #16 SHOULD INCLUDE?</b></p> <p><b>WHAT PROBLEM WAS RUNNING THROUGH PREVIOUS DISCUSSIONS?</b></p> <p><b>[YOU CAN ADD A POST-IT NOTE BY DOUBLE-CLICKING IN MURAL]</b></p>
	<b>Debrief</b>	<ul style="list-style-type: none"> <li>• Inform participants that you have now reached the end of the formal workshop.</li> <li>• Ask if they have any remaining questions.</li> <li>• Thank participants for their time and tell them ways in which they can stay in touch.</li> <li>• Mention the integrative workshop and/or second workshop.</li> </ul> <p><b>[END RECORDING]</b></p>
	<b>Contingencies</b>	<ol style="list-style-type: none"> <li>1. What should I do if a participant(s) do not join the online workshop? What is the minimum number which we will run the call with?</li> </ol> <p>At &lt;2 participants, switch to an alternative protocol.</p> <ol style="list-style-type: none"> <li>2. What should I do if Teams does not work?</li> </ol> <p>Send participants a link to Webex (or other backup software).</p>



	<p>3. What should I do if neither Teams nor the back up software works?</p> <p>Ask backup moderator if they can take over or find another suitable date with participants by email.</p> <p>4. What should I do if there is a glitch and a participant drops out?</p> <p>Continue and make a note of when they left the call – if they manage to reconnect, then bring them up to speed with what has been said. Invite them to join a subsequent workshop (if possible).</p> <p>5. What should I do if there is a glitch and the moderator drops out temporarily?</p> <p>Send them a chat/email informing participants that you will reconnect. If you cannot reconnect after 5 minutes, inform the back-up moderator and ask them to take over.</p> <p>6. What should I do if a participant's video does not work?</p> <p>Continue with audio only.</p> <p>7. What should I do if a participant's audio does not work?</p> <p>Ask them to reconnect – if problem persists, ask them to check their audio settings. Invite them (by chat/email) to subsequent workshop.</p> <p>8. What should I do if one or more participants can't use Mural/see the option cards?</p> <p>Use screensharing – if fidelity is still too low, send the option card PPT slides to the Teams group.</p> <p>9. What should I do if a voice recorder does not work?</p> <p>Use your mobile phone to record audio (most have applications for dedicated audio recording, otherwise record a video).</p>
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		<p>10. What should I do if too many participants come to the event?</p> <p>Take their details, give them a name tag and have them join any of the other focus groups.</p> <p>11. What should I do if someone is very late?</p> <p>If they join before or while the group is reviewing the options for the first category, allow them to join and bring them up to speed while the rest of the group reviews the options, giving them time to look at these as well. If they join after this point, ask them to join another focus group at a later date.</p> <p>12. What should I do if there is a fire alarm or other emergency during the call?</p> <p>Inform participants that this is not a drill and tell them that you will have to leave the building and that the back up moderator will take over shortly. Ask them to wait in the call and review the option cards for that section while they wait. Exit the building, bringing the voice recorder and laptop with you. Once safe, contact the back up moderator and ask them to take over the call if your participants have not already done so.</p> <p>13. What should I do if one person is dominating the focus group?</p> <p>Start by asking for direct responses from other participants (e.g. "Does anyone have a different view?"). If it persists, you can directly ask the disruptive person to give others a chance to speak or throw them a stern look. As a last resort, they can be asked to leave.</p>
	<b>Transcription</b>	<p>Video/audio files should be uploaded to the secure shared drive ASAP in the following format:</p> <p><i>[moderator initials] – [date] – [workshop #] – [number participants]</i></p>



		Example: <b>JM – 09032020 – 22A - 4</b>
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# **CropBooster-P**

## **Annex 2: Option Cards**



# SUSTAINABILITY

Improving how plants use resources and cope with stresses like heat or drought.

## SUSTAINABILITY

### IMPROVING NITROGEN UPTAKE AND USE



Nitrogen is one of the most important plant nutrients. It is used in key processes like making protein and in photosynthesis.

This option includes a range of breeding technologies that aim to improve the uptake of nitrogen from the soil and help the plant use it more efficiently, meaning less needs to be applied to the crop.

## SUSTAINABILITY

### EXAMPLE: Borrowing a gene from barley to improve wheat



Improved height and biomass has been seen in wheat with the Barley *HvAlaAT* gene in low nitrogen field conditions (Pena et al., 2017)

flickr.com/photos/orthodox\_ideas



## SUSTAINABILITY

### IMPROVING PLANT WATER USE

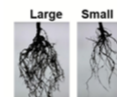


Lack of water affects plant productivity and can decrease crop quality.

This option includes a range of breeding technologies that aim to improve uptake of water from soil, reduce water loss in the plant and help it use water more efficiently.

## SUSTAINABILITY

### EXAMPLE: Improving roots to cope with water stress



Larger root systems can extract more water and nutrients under stress conditions in crops – improving root systems could improve plant stress tolerance (Ye et al., 2018).

## SUSTAINABILITY

### IMPROVING PHOSPHOROUS UPTAKE AND USE



Phosphorous is one of the most important plant nutrients. It is used in key processes like respiration and photosynthesis.

This option includes a range of breeding technologies that aim to improve the uptake of phosphorous from the soil and help the plant use it more efficiently, so less will need to be applied to the crop.

## SUSTAINABILITY

### EXAMPLE: A gene from traditional rice can improve crop performance



The gene *PSTOL1* enhances root growth and phosphorous uptake in traditional rice varieties. By incorporating this gene into modern varieties, productivity could be improved in regions with low phosphorous content (Gamuyao, 2012).



## SUSTAINABILITY

### IMPROVING HEAT STRESS TOLERANCE



Plants can be damaged by being exposed to high levels of heat. Too much heat can harm plant reproduction.

This option includes a range of breeding technologies that aim to improve the plant's ability to cope with high temperatures.

## SUSTAINABILITY

### EXAMPLE: Heat stress targets in wheat



Researchers have identified wheat varieties with high levels of resistance to heat stress.

These varieties are better able to continue photosynthesis and cooling their leaves during heat stress. Breeders can use these traits to develop better varieties in the future. (Sharma et al., 2014)

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## SUSTAINABILITY

### IMPROVING SALT STRESS TOLERANCE



Plants can be damaged by being exposed to too much salt. For example, too much salt in water can mean that plants end up absorbing salt instead of nutrients.

This option includes a range of breeding technologies which aim to reduce crop sensitivity to and improve tolerance of salt.

## SUSTAINABILITY

### EXAMPLE: Salt stress targets in rice



Researchers have identified several DNA regions which are linked to the uptake of different salts in rice. These can be used to breed varieties of rice which are more resistant to high levels of salt (Koyama et al., 2001).

flickr.com/photos/matsuyuki





# YIELD

Increasing the total amount of edible or usable material produced by the plant.

## YIELD

### IMPROVING PHOTOSYNTHESIS

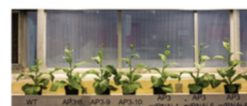


Photosynthesis is the process of turning the energy from the sun into usable energy in the form of sugar.

This option includes a range of breeding technologies that aim to increase the efficiency of photosynthesis.

## YIELD

### EXAMPLE: Improving photosynthesis for more biomass



By reducing the amount of energy the plant spends on respiration, scientists were able to increase plant biomass by 40% in tobacco (South et al., 2019).



## YIELD

### INCREASING THE SIZE OF HARVESTABLE PARTS

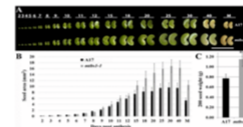


Increasing the size of harvestable parts of crops could increase the total yield that can be produced by a single plant.

This option includes a range of breeding technologies that aim to increase the size of grains, fruits and tubers.

## YIELD

### EXAMPLE: Removing a gene leads to bigger seeds



The *BS1* gene regulates plant growth. Removing the gene has been shown to increase the size of leaves and seed in soybeans (Ge et al., 2016).

## YIELD

### IMPROVING THE USE AND MOVEMENT OF NUTRIENTS WITHIN THE PLANT



This option includes a range of breeding technologies that aim to help plants use and move nutrients to the parts of the plant where they are needed.

For example, plants do not always maximise their storage of carbon in the harvestable part of the plant; changing where plants store key nutrients could help to increase yield.

## YIELD

### EXAMPLE: Improving the flow of nutrients to the grain



The *NAM-B1* gene helps to control the flow of nutrients like iron, zinc and magnesium from leaves to grain (Waters et al., 2009). By boosting this gene, it may be possible to improve grain filling in cereal crops.

flickr.com/photos/tillwa



## YIELD

### ALTERING GROWING SEASON OF PLANTS



Plants suffer different stresses at different times of the growing season, such as damage caused by heat during flowering.

This option includes a range of breeding technologies to change when the plant emerges, flowers, and dies.

## YIELD

### EXAMPLE: Heat tolerance and earlier grain emergence a priority



Gouache et al. (2012) show that heat tolerance and early grain emergence are more efficient than earlier planting for coping with heat stress. These could be future wheat breeding aims.

flickr.com/photos/38464

## YIELD

### IMPROVING DIGESTIBILITY OF BIOMASS



Plant material can be broken down into sugars and used for a wide range of purposes, including bio-fuels.

This option includes a range of breeding technologies that aim to produce plants which are easier to process into sugars.

## YIELD

### EXAMPLE: Reducing lignin content



Lignin is an important for plants and helps make their stems rigid. However, high levels of lignin make digesting plants difficult. Reducing lignin production in alfalfa has been found to nearly double sugar yield from plant digestion (Chen and Dixon, 2007).

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# NUTRITION

Increasing the amount of plant components which are beneficial to human health (or decreasing the amount of those which are harmful to human health).

## NUTRITION

### INCREASING VITAMIN AND MINERAL CONTENT



This option includes a range of breeding technologies that aim to increase the content of vitamins and/or minerals which are beneficial to human health, whilst maintaining plant health.

## NUTRITION

### EXAMPLE: Improving carotenoid content in potato



By suppressing the CHY1 and CHY2 genes, researchers have been able to boost the amount of beta-carotene in potato (Diretto et al., 2007). Humans are able to convert carotenoids into Vitamin A.

flickr.com/photos/sedroscopie



## NUTRITION

### INCREASING PROTEIN CONTENT AND QUALITY



Protein is an essential part of the human diet and is made of amino acids. Certain types of protein are useful because they contain high levels of specific amino acids that humans need to build muscle.

This option includes a range of breeding technologies that aim to increase the protein content of crops whilst maintaining yield.

## NUTRITION

### EXAMPLE: Improving protein content of wheat



The *NAM-A1* gene has been linked to grain protein content in wheat (Uauy et al., 2006). By boosting this gene, it is possible to improve grain protein content in cereal crops.

flickr.com/photos/alphazeta

## NUTRITION

### DECREASING NEGATIVE AND TOXIC COMPOUNDS



Antinutrients are produced by plants to defend themselves from pests, but these can reduce the nutrient uptake in humans.

Toxic metabolites can cause harm to humans who eat them.

This option includes a range of breeding technologies that aim to reduce antinutrient and toxic metabolite production, so that more parts of the plant can be eaten safely.

## NUTRITION

### EXAMPLE: Reducing the content of phytic acid in maize and soybean



The *LPA1* gene controls the production of phytic acid, which negatively affects animal nutrition.

Suppressing this gene leads to crops with lower phytic acid content (Shi, 2007).

flickr.com/photos/unitedsoybean



## NUTRITION

### INCREASING ANTIOXIDANT CONTENT



Antioxidants are found in fruits, vegetables and cereal crops. They provide a range of human health benefits, such as protection against cancer, diabetes and heart disease.

This option includes a range of breeding technologies that aim to increase the amount of antioxidants found in the edible parts of plants.

## NUTRITION

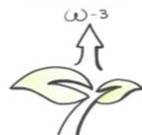
### EXAMPLE: Anthocyanin in tomato



The *ANT1* gene in tomatoes controls the production of the antioxidant *anthocyanin*. By editing this gene, scientists were able to produce tomatoes with much higher levels of anthocyanin than normal (Čermák et al., 2015).

## NUTRITION

### PRODUCING HEALTHY OMEGA-3 FATTY ACIDS IN OILSEEDS



Omega-3 fatty acids are essential components of a healthy balanced diet. At the moment, these are mainly found in seafood.

This option includes a range of breeding technologies which aim to produce omega-3 fatty acids in oilseeds, providing a new dietary source for humans.

## NUTRITION

### EXAMPLE: Omega 3 production in Camelina



By introducing the *FAH12* gene into *Camelina sativa* oilseed plants, scientists have created a variety which can produce beneficial omega-3 fatty acids without reducing total oil yield (Usher et al., 2015).

flickr.com/photos/wiaerland



OPTION CARD #16

**NAME:** \_\_\_\_\_



Description: \_\_\_\_\_

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OPTION CARD #16

**EXAMPLE:** \_\_\_\_\_

Description: \_\_\_\_\_

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THIS PROJECT IS FUNDED BY THE  
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GRANT AGREEMENT 817690

Increasing nitrogen uptake and use  
Improving phosphorus uptake and use  
Improving root system architecture  
Improving water use  
Improving salt tolerance

Improving photosynthesis  
Improving use and movement of nutrients  
Altering growing season  
Improving digestibility of biomass  
Increasing size of harvestable parts

## Sustainability

<b>ADAPTATION 1</b> <b>REDUCING WATER REQUIREMENTS</b> Improving water use efficiency through root system architecture and leaf morphology changes. This can be achieved by selecting for traits such as deeper roots, smaller leaves, and waxy cuticles. This reduces the need for irrigation and improves drought tolerance.	<b>ADAPTATION 2</b> <b>IMPROVING NITROGEN EFFICIENCY</b> Selecting for traits that improve nitrogen uptake and use, such as deeper roots and increased root surface area. This reduces the need for synthetic fertilizers and improves soil health.
<b>ADAPTATION 3</b> <b>IMPROVING PHOSPHORUS EFFICIENCY</b> Selecting for traits that improve phosphorus uptake and use, such as mycorrhizal associations and increased root surface area. This reduces the need for synthetic fertilizers and improves soil health.	<b>ADAPTATION 4</b> <b>IMPROVING SALT TOLERANCE</b> Selecting for traits that improve salt tolerance, such as improved ion balance and osmotic adjustment. This allows crops to grow in saline soils and reduces the need for desalination.
<b>ADAPTATION 5</b> <b>IMPROVING DROUGHT TOLERANCE</b> Selecting for traits that improve drought tolerance, such as deeper roots and improved water use efficiency. This reduces the need for irrigation and improves crop resilience.	<b>ADAPTATION 6</b> <b>IMPROVING HEAVY METAL TOLERANCE</b> Selecting for traits that improve heavy metal tolerance, such as improved ion balance and detoxification pathways. This allows crops to grow in contaminated soils and reduces the need for remediation.
<b>ADAPTATION 7</b> <b>IMPROVING PEST AND DISEASE RESISTANCE</b> Selecting for traits that improve pest and disease resistance, such as natural defenses and improved plant architecture. This reduces the need for pesticides and improves crop health.	<b>ADAPTATION 8</b> <b>IMPROVING CLIMATE RESILIENCE</b> Selecting for traits that improve climate resilience, such as improved heat tolerance and improved water use efficiency. This allows crops to grow in a changing climate and reduces the need for irrigation.

## Nutrition

<b>ADAPTATION 1</b> <b>IMPROVING PROTEIN CONTENT</b> Selecting for traits that improve protein content, such as increased nitrogen uptake and use. This improves the nutritional value of the crop and reduces the need for protein supplements.	<b>ADAPTATION 2</b> <b>IMPROVING FIBER CONTENT</b> Selecting for traits that improve fiber content, such as increased cell wall thickness and improved lignin content. This improves the digestibility of the crop and reduces the need for fiber supplements.
<b>ADAPTATION 3</b> <b>IMPROVING ANTIOXIDANT CONTENT</b> Selecting for traits that improve antioxidant content, such as increased phenolic content and improved antioxidant enzymes. This improves the health benefits of the crop and reduces the need for antioxidants.	<b>ADAPTATION 4</b> <b>IMPROVING MINERAL CONTENT</b> Selecting for traits that improve mineral content, such as increased calcium and potassium uptake. This improves the nutritional value of the crop and reduces the need for mineral supplements.
<b>ADAPTATION 5</b> <b>IMPROVING OMEGA-3 CONTENT</b> Selecting for traits that improve omega-3 content, such as increased linolenic acid content. This improves the health benefits of the crop and reduces the need for omega-3 supplements.	<b>ADAPTATION 6</b> <b>IMPROVING TASTE AND QUALITY</b> Selecting for traits that improve taste and quality, such as improved sugar content and improved texture. This improves the consumer acceptance of the crop and reduces the need for flavor enhancers.

## Yield

<b>ADAPTATION 1</b> <b>IMPROVING PHOTOSYNTHESIS</b> Selecting for traits that improve photosynthesis, such as increased chlorophyll content and improved light use efficiency. This increases the biomass of the crop and reduces the need for fertilizers.	<b>ADAPTATION 2</b> <b>IMPROVING GROWING SEASON</b> Selecting for traits that improve the growing season, such as improved cold tolerance and improved heat tolerance. This allows crops to be grown in a wider range of climates and reduces the need for climate control.
<b>ADAPTATION 3</b> <b>IMPROVING DROUGHT TOLERANCE</b> Selecting for traits that improve drought tolerance, such as deeper roots and improved water use efficiency. This increases the biomass of the crop and reduces the need for irrigation.	<b>ADAPTATION 4</b> <b>IMPROVING PEST AND DISEASE RESISTANCE</b> Selecting for traits that improve pest and disease resistance, such as natural defenses and improved plant architecture. This increases the biomass of the crop and reduces the need for pesticides.
<b>ADAPTATION 5</b> <b>IMPROVING HEAVY METAL TOLERANCE</b> Selecting for traits that improve heavy metal tolerance, such as improved ion balance and detoxification pathways. This allows crops to be grown in contaminated soils and reduces the need for remediation.	<b>ADAPTATION 6</b> <b>IMPROVING CLIMATE RESILIENCE</b> Selecting for traits that improve climate resilience, such as improved heat tolerance and improved water use efficiency. This allows crops to be grown in a changing climate and reduces the need for irrigation.

## Option Card #16

<b>ADAPTATION 1</b> <b>REDUCING WATER REQUIREMENTS</b>	<b>ADAPTATION 2</b> <b>IMPROVING NITROGEN EFFICIENCY</b>
<b>ADAPTATION 3</b> <b>IMPROVING PHOSPHORUS EFFICIENCY</b>	<b>ADAPTATION 4</b> <b>IMPROVING SALT TOLERANCE</b>
<b>ADAPTATION 5</b> <b>IMPROVING DROUGHT TOLERANCE</b>	<b>ADAPTATION 6</b> <b>IMPROVING HEAVY METAL TOLERANCE</b>
<b>ADAPTATION 7</b> <b>IMPROVING PEST AND DISEASE RESISTANCE</b>	<b>ADAPTATION 8</b> <b>IMPROVING CLIMATE RESILIENCE</b>

Increasing antioxidant content  
Increasing protein content and quality  
Decreasing negative and toxic compounds  
Producing healthy omega-3  
Increasing mineral and vitamin content





# CropBooster-P

## Annex 3: Standardised Workshop Invitation

### Invitation to participate in CropBooster-P workshop

Dear [participant],

You are invited to take part in a two-hour workshop on [date, location, timing].

The workshop is part of CropBooster-P, a European Union project bringing together researchers and stakeholder across Europe to map and assess current and future strategies for crop genetic improvement. You can find out more about the project on our website, at <https://www.cropbooster-p.eu/>.

As a member of [insert occupation/relevant group], we want your opinions on the potential impacts of several strategies for crop improvement that we have identified.

The workshop will involve a brief presentation, followed by short discussions in small groups around key options previously identified by the project for improving yield, nutritional quality, and sustainability. These discussions will be audio recorded for later analysis by Lancaster University (United Kingdom) and Wageningen University (Netherlands) teams. Your contributions will be fully anonymised.

By taking part in this workshop, you will help us to understand the priorities you have for crop improvement and will help steer European plant breeding and policy.

If you are interested in taking part, please confirm by email to [contact] by [date], and read the attached participant information sheet, which contains more details about the study and data protection prior to the workshop.

If you have any questions, please do not hesitate to contact [contact].

Best wishes,

[contact – this will vary depending on workshop]



# **CropBooster-P**

## **Annex 4: Survey**



# CropBooster-P Survey

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## Start of Block: Shared Demographic Questions

Q8 This survey is part of CropBooster-P, an EU project bringing together researchers and stakeholders across Europe to map and assess strategies for crop improvement. You can find out more about the project on our website at [www.cropbooster-p.eu](http://www.cropbooster-p.eu). As a member of the European food system, we want your opinions on the potential importance of several strategies for crop improvement that we have identified around improving the yield, nutritional quality, and sustainability of European crops. By completing this survey you are agreeing to have your results analysed as part of this project. Individual responses will be kept anonymous and will be used by the CropBooster-P team to better understand priorities for crop improvement in Europe. They may also form the basis of publications. Your data will be stored securely and anonymously and may be used in future research projects. The results of this survey will be analysed by researchers at Lancaster University (United Kingdom) and Wageningen University (Netherlands). You may request to have your response removed from the survey during the data collection phase. To do this, you must email [iss@lancaster.ac.uk](mailto:iss@lancaster.ac.uk) before 18 May 2020 with the email address you used when filling in the survey. Beyond this date, your data will no longer be able to be removed from the analysis. If you have any questions, please do not hesitate to contact Dr Stacia Stetkiewicz, Dr Jonathan Menary, or Dr Abhishek Nair - [s.stetkiewicz@lancaster.ac.uk](mailto:s.stetkiewicz@lancaster.ac.uk); [j.menary@lancaster.ac.uk](mailto:j.menary@lancaster.ac.uk); [abhishek.nair@wur.nl](mailto:abhishek.nair@wur.nl). [Click here to view the survey in French](#)  
[Click here to view the survey in German](#)

---

Q3 What is your current age?

▼ Under 18 ... Over 100

---

*Skip To: End of Survey If What is your current age? = Under 18*

---



Q9 Which of the following best describes you?

- ☐ Involved in farm-level activities
- ☐ Involved in agri-business or the food supply chain
- ☐ Consumer or consumer representative
- ☐ Plant scientist

End of Block: Shared Demographic Questions

---

Start of Block: Ranking



Q38

In this section, you will be asked about how important different crop improvement options are in terms of future-proofing European crops.

Future-proofing crops is used to refer to improving crops in order to prepare them for the future needs of society and the challenges which will be faced by food systems between now and 2050.

Please rank the following goals in terms of importance to future-proofing European crops, with 1 being most important and 3 least important.

- \_\_\_\_\_ Increasing yield
- \_\_\_\_\_ Improving nutritional quality
- \_\_\_\_\_ Improving sustainability

Q39 Please briefly describe why you have prioritised your chosen goal (in 1000 characters or less).

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Q42 Please indicate how important you feel each of the following options are for future-proofing European crops.

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Q57

Please indicate how important you feel this option is for future-proofing European crops:

- ☐ Very unimportant
  - ☐ Unimportant
  - ☐ Neither important nor unimportant
  - ☐ Important
  - ☐ Very important
  - ☐ Don't know
- 

Q47

Please indicate how important you feel this option is for future-proofing European crops:



- ☐ Very unimportant
  - ☐ Unimportant
  - ☐ Neither important nor unimportant
  - ☐ Important
  - ☐ Very important
  - ☐ Don't know
- 

Q55

Please indicate how important you feel this option is for future-proofing European crops:

- ☐ Very unimportant
  - ☐ Unimportant
  - ☐ Neither important nor unimportant
  - ☐ Important
  - ☐ Very important
  - ☐ Don't know
- 

Q49

Please indicate how important you feel this option is for future-proofing European crops:



- ☐ Very unimportant
  - ☐ Unimportant
  - ☐ Neither important nor unimportant
  - ☐ Important
  - ☐ Very important
  - ☐ Don't know
- 

Q54

Please indicate how important you feel this option is for future-proofing European crops:

- ☐ Very unimportant
  - ☐ Unimportant
  - ☐ Neither important nor unimportant
  - ☐ Important
  - ☐ Very important
  - ☐ Don't know
- 

Q51

Please indicate how important you feel this option is for future-proofing European crops:



- ☐ Very unimportant
  - ☐ Unimportant
  - ☐ Neither important nor unimportant
  - ☐ Important
  - ☐ Very important
  - ☐ Don't know
- 

Q56

Please indicate how important you feel this option is for future-proofing European crops:

- ☐ Very unimportant
  - ☐ Unimportant
  - ☐ Neither important nor unimportant
  - ☐ Important
  - ☐ Very important
  - ☐ Don't know
- 

Q52

Please indicate how important you feel this option is for future-proofing European crops:





- ☐ Very unimportant
  - ☐ Unimportant
  - ☐ Neither important nor unimportant
  - ☐ Important
  - ☐ Very important
  - ☐ Don't know
- 

Q46

Please indicate how important you feel this option is for future-proofing European crops:

- ☐ Very unimportant
  - ☐ Unimportant
  - ☐ Neither important nor unimportant
  - ☐ Important
  - ☐ Very important
  - ☐ Don't know
- 

Q53

Please indicate how important you feel this option is for future-proofing European crops:



- ☐ Very unimportant
  - ☐ Unimportant
  - ☐ Neither important nor unimportant
  - ☐ Important
  - ☐ Very important
  - ☐ Don't know
- 

Q48

Please indicate how important you feel this option is for future-proofing European crops:

- ☐ Very unimportant
  - ☐ Unimportant
  - ☐ Neither important nor unimportant
  - ☐ Important
  - ☐ Very important
  - ☐ Don't know
- 

Q41

Please indicate how important you feel this option is for future-proofing European crops:



- ☐ Very unimportant
  - ☐ Unimportant
  - ☐ Neither important nor unimportant
  - ☐ Important
  - ☐ Very important
  - ☐ Don't know
- 

Q44

Please indicate how important you feel this option is for future-proofing European crops:

- ☐ Very unimportant
  - ☐ Unimportant
  - ☐ Neither important nor unimportant
  - ☐ Important
  - ☐ Very important
  - ☐ Don't know
- 

Q50

Please indicate how important you feel this option is for future-proofing European crops:



- ☐ Very unimportant
  - ☐ Unimportant
  - ☐ Neither important nor unimportant
  - ☐ Important
  - ☐ Very important
  - ☐ Don't know
- 

Q90

Please indicate how important you feel this option is for future-proofing European crops:

- ☐ Very unimportant
  - ☐ Unimportant
  - ☐ Neither important nor unimportant
  - ☐ Important
  - ☐ Very important
  - ☐ Don't know
- 



Q59 Are there any other goals which were not included in the above list, but which you feel are important for future-proofing crops? If so, please provide a brief description below. (in 1000 characters or less)

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End of Block: Ranking

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Start of Block: Shared demographic questions part 2

Q2 Are you contributing to a CropBooster-P focus group in spring 2020?

- ☐ Yes
- ☐ No
- ☐ Unsure
- ☐ Other, please specify: \_\_\_\_\_

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Page Break

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Q1 Capacity in which you are filling in this survey (this could be your job title, an organisation you represent, or simply as an interested individual)

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Page Break



Q4 What is your sex?

Why are we asking? - We are collecting this information in order to check the representation of different age, gender, and geographic groups in our survey - for example, if the majority of our responses are coming from one particular region of Europe, this might be important when interpreting our results.

- ☐ Male
- ☐ Female
- ☐ Prefer not to say
- 

Q5 What is your home postcode? (UK respondents, please give at least the first three characters of your postcode)

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Page Break



Q6 Formal education level (please indicate the highest applicable to you - hover over the answer choices for examples / or [click here](#) for examples)

- ☐ Less than primary education
- ☐ Primary education
- ☐ Lower secondary education
- ☐ Upper secondary education
- ☐ Post-secondary non-tertiary education
- ☐ Short-cycle tertiary education
- ☐ Bachelor's or equivalent degree
- ☐ Master's or equivalent degree
- ☐ Doctoral or equivalent degree
- ☐ Other, please specify: \_\_\_\_\_

---

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Q78 Which country do you live in? (if you split your time between multiple countries, please indicate the country of your primary residence)

- ☐ Austria
- ☐ Belgium
- ☐ Bulgaria
- ☐ Croatia
- ☐ Cyprus
- ☐ Czech Republic
- ☐ Denmark
- ☐ Estonia
- ☐ Finland
- ☐ France
- ☐ Germany
- ☐ Greece
- ☐ Hungary
- ☐ Iceland
- ☐ Ireland
- ☐ Italy
- ☐ Latvia
- ☐ Lithuania
- ☐ Luxembourg
- ☐ Malta
- ☐ Montenegro



- ☐ Netherlands
- ☐ Norway
- ☐ Poland
- ☐ Portugal
- ☐ Romania
- ☐ Slovakia
- ☐ Slovenia
- ☐ Spain
- ☐ Sweden
- ☐ Switzerland
- ☐ United Kingdom
- ☐ Other, please specify: \_\_\_\_\_

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Q15 Which crops do you feel are most important for the future of European agriculture? (choose up to 5)

- ☐ Barley
- ☐ Carrots
- ☐ Grain maize and corn-cob mix
- ☐ Grapes
- ☐ Oats
- ☐ Olives
- ☐ Onions
- ☐ Potatoes
- ☐ Rape and turnip rape seeds
- ☐ Rice
- ☐ Rye and maslin
- ☐ Sorghum
- ☐ Soya
- ☐ Spelt
- ☐ Sugar beet
- ☐ Sunflower seeds
- ☐ Tomatoes



- ☐ Triticale
- ☐ Wheat
- ☐ Other, please specify: \_\_\_\_\_

End of Block: Shared demographic questions part 2

---

Start of Block: Farm level questions

*Display This Question:*

*If Which of the following best describes you? = Involved in farm-level activities*

Q11 Which of the following best describes you:

- ☐ Farmer
- ☐ Farmer representative
- ☐ Farm support/advisor
- ☐ Environmental regulator or policy maker
- ☐ Scientific expert in resource use efficiency, environmental impacts, etc.
- ☐ NGO with a focus on farm-level concerns, such as the environmental impacts of farming
- ☐ Other farm-level stakeholder, please specify:  
\_\_\_\_\_

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Page Break



*Display This Question:*

*If Which of the following best describes you? = Involved in farm-level activities*

Q12 What is your highest level of agricultural education?

- ☐ Only practical experience on-farm
- ☐ Basic agricultural training (this includes a completed agricultural apprenticeship)
- ☐ Full agricultural training (two or more years of full-time higher education)
- ☐ Other, please specify: \_\_\_\_\_
- ☐ Not applicable

---

Page Break



*Display This Question:*

*If Which of the following best describes you? = Involved in farm-level activities*

*And Which of the following best describes you: = Farmer*

*Or Which of the following best describes you: = Other farm-level stakeholder, please specify:*

Q13 Is your farm mixed animal and crop farming, or solely crops?

- ☐ Mixed crop and animal farming
- ☐ Crop specialist
- ☐ Animal specialist
- ☐ Not applicable

---

Page Break





*Display This Question:*

*If Which of the following best describes you? = Involved in farm-level activities*

*And Which of the following best describes you: = Farmer representative*

*Or Which of the following best describes you: = Farm support/advisor*

*Or Which of the following best describes you: = Other farm-level stakeholder, please specify:*

Q14 What types of farms do you primarily represent/work with?

- ☐ Mixed crop and animal farming
- ☐ Crop specialists
- ☐ Animal specialists
- ☐ Not applicable

-----  
Page Break

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*Display This Question:*

*If Which of the following best describes you? = Involved in farm-level activities*





Q16 Which crops do you primarily work with or on? (choose up to five)

- ☐ Barley
- ☐ Carrots
- ☐ Grain maize and corn-cob mix
- ☐ Grapes
- ☐ Oats
- ☐ Olives
- ☐ Onions
- ☐ Potatoes
- ☐ Rape and turnip rape seeds
- ☐ Rice
- ☐ Rye and maslin
- ☐ Sorghum
- ☐ Soya
- ☐ Spelt
- ☐ Sugar beet
- ☐ Sunflower seeds
- ☐ Tomatoes



☐ Triticale

☐ Wheat

☐ Other, please specify: \_\_\_\_\_

☐ Not applicable

---

Page Break



*Display This Question:*

*If Which of the following best describes you? = Involved in farm-level activities*

*And Which of the following best describes you: = Farmer*



Q17 What country is your farm located in?

- ☐ Austria
- ☐ Belgium
- ☐ Bulgaria
- ☐ Croatia
- ☐ Cyprus
- ☐ Czech Republic
- ☐ Denmark
- ☐ Estonia
- ☐ Finland
- ☐ France
- ☐ Germany
- ☐ Greece
- ☐ Hungary
- ☐ Iceland
- ☐ Ireland
- ☐ Italy
- ☐ Latvia
- ☐ Lithuania
- ☐ Luxembourg
- ☐ Malta
- ☐ Montenegro



- ☐ Netherlands
- ☐ Norway
- ☐ Poland
- ☐ Portugal
- ☐ Romania
- ☐ Slovakia
- ☐ Slovenia
- ☐ Spain
- ☐ Sweden
- ☐ Switzerland
- ☐ United Kingdom
- ☐ Other, please specify: \_\_\_\_\_

---

Page Break \_\_\_\_\_



*Display This Question:*

*If Which of the following best describes you: = Farmer*

Q18 What size is your farm in total? (including rented land)

- ☐ 0 – less than 2 ha
- ☐ 2 – 4.9 ha
- ☐ 5 – 9.9 ha
- ☐ 10 – 19.9 ha
- ☐ 20 – 29.9 ha
- ☐ 30 – 49.9 ha
- ☐ 50 – 99.9 ha
- ☐ 100 ha or over

---

Page Break





*Display This Question:*

*If Which of the following best describes you: = Farmer*



Q19 What are the current primary markets for your crops? (choose up to three)

☐ Animal Feed

☐ Human food

☐ Fuel

☐ Drinks industry

☐ Other, please specify: \_\_\_\_\_

---

Page Break



*Display This Question:*

*If Which of the following best describes you: = Farmer*

Q20 Does your farm have any specific certifications or organisational affiliations, or are you a member of any specific agri-environmental schemes, such as Organic, LEAF, etc? (please indicate any which apply, even if they do not apply to your entire farm)

- ☐ Yes, please specify: \_\_\_\_\_
- ☐ No
- ☐ Unsure

-----

Page Break \_\_\_\_\_



*Display This Question:*

*If Which of the following best describes you: = Farmer*

Q21 Do you own or rent your farm?

- ☐ Own
- ☐ Rent
- ☐ Own some, rent some (please specify approximate hectares for each)  
\_\_\_\_\_
- ☐ Other, please specify \_\_\_\_\_

-----  
Page Break \_\_\_\_\_



*Display This Question:*

*If Which of the following best describes you? = Involved in farm-level activities*

*And Which of the following best describes you: != Farmer*



Q22 Which country do you primarily work in?

- ☐ Austria
- ☐ Belgium
- ☐ Bulgaria
- ☐ Croatia
- ☐ Cyprus
- ☐ Czech Republic
- ☐ Denmark
- ☐ Estonia
- ☐ Finland
- ☐ France
- ☐ Germany
- ☐ Greece
- ☐ Hungary
- ☐ Iceland
- ☐ Ireland
- ☐ Italy
- ☐ Latvia
- ☐ Lithuania
- ☐ Luxembourg
- ☐ Malta
- ☐ Montenegro



- ☐ Netherlands
- ☐ Norway
- ☐ Poland
- ☐ Portugal
- ☐ Romania
- ☐ Slovakia
- ☐ Slovenia
- ☐ Spain
- ☐ Sweden
- ☐ Switzerland
- ☐ United Kingdom
- ☐ Other, please specify: \_\_\_\_\_

---

Page Break \_\_\_\_\_



*Display This Question:*

*If Which of the following best describes you? = Involved in farm-level activities*

*And Which of the following best describes you: != Farmer*

Q23 If you are a farm advisor, or frequently work with farmers, what is the average size of farm you usually work with?

- ☐ 0 – less than 2 ha
- ☐ 2 – 4.9 ha
- ☐ 5 – 9.9 ha
- ☐ 10 – 19.9 ha
- ☐ 20 – 29.9 ha
- ☐ 30 – 49.9 ha
- ☐ 50 – 99.9 ha
- ☐ 100 ha or over
- ☐ Unsure
- ☐ Not applicable

---

Page Break



Display This Question:

*If Which of the following best describes you? = Involved in farm-level activities*

*And Which of the following best describes you: != Farmer*



Q24 What are the primary markets for the crops you usually work with or on? (choose up to three)

- ☐ Animal Feed
- ☐ Human food
- ☐ Fuel
- ☐ Drinks industry
- ☐ Other, please specify: \_\_\_\_\_
- ☐ Unsure
- ☐ Not applicable

---

Page Break





*Display This Question:*

*If Which of the following best describes you? = Involved in farm-level activities*

*And Which of the following best describes you: != Farmer*

Q25 Which of the following best describes the company or organisation you work for/are a part of?

- ☐ Farm/farmer
- ☐ NGO
- ☐ Research institute
- ☐ Higher education institute
- ☐ Business
- ☐ Farm advisory group
- ☐ Other, please specify: \_\_\_\_\_

End of Block: Farm level questions

---

Start of Block: Business level questions

*Display This Question:*

*If Which of the following best describes you? = Involved in agri-business or the food supply chain*



Q26 Which of the following best describes you?

- ☐ Agri-food business member (other than farmers)
- ☐ Agri-food business representative
- ☐ Trade or supply chain expert
- ☐ Agricultural technology expert
- ☐ Agricultural economist
- ☐ Plant breeder
- ☐ NGO with a focus on business-level concerns, such as sharing of genetic material for breeding
- ☐ Other business-level stakeholder, please specify:  
\_\_\_\_\_

---

Page Break



*Display This Question:*

*If Which of the following best describes you? = Involved in agri-business or the food supply chain*





Q28 Which crops do you primarily work with or on? (choose up to 5)

- ☐ Barley
- ☐ Carrots
- ☐ Grain maize and corn-cob mix
- ☐ Grapes
- ☐ Oats
- ☐ Olives
- ☐ Onions
- ☐ Potatoes
- ☐ Rape and turnip rape seeds
- ☐ Rice
- ☐ Rye and maslin
- ☐ Sorghum
- ☐ Soya
- ☐ Spelt
- ☐ Sugar beet
- ☐ Sunflower seeds
- ☐ Tomatoes



☐ Triticale

☐ Wheat

☐ Other, please specify: \_\_\_\_\_

☐ Not applicable

---

Page Break \_\_\_\_\_



*Display This Question:*

*If Which of the following best describes you? = Involved in agri-business or the food supply chain*



Q29 Which country do you primarily work in?

- ☐ Austria
- ☐ Belgium
- ☐ Bulgaria
- ☐ Croatia
- ☐ Cyprus
- ☐ Czech Republic
- ☐ Denmark
- ☐ Estonia
- ☐ Finland
- ☐ France
- ☐ Germany
- ☐ Greece
- ☐ Hungary
- ☐ Iceland
- ☐ Ireland
- ☐ Italy
- ☐ Latvia
- ☐ Lithuania
- ☐ Luxembourg
- ☐ Malta
- ☐ Montenegro



- ☐ Netherlands
- ☐ Norway
- ☐ Poland
- ☐ Portugal
- ☐ Romania
- ☐ Slovakia
- ☐ Slovenia
- ☐ Spain
- ☐ Sweden
- ☐ Switzerland
- ☐ United Kingdom
- ☐ Other, please specify: \_\_\_\_\_

---

Page Break \_\_\_\_\_





*Display This Question:*

*If Which of the following best describes you? = Involved in agri-business or the food supply chain*

Q30 Which of the following best describes the company or organisation you work for:

- ☐ Seed breeding and supply
- ☐ Fertiliser or chemical input supplier
- ☐ Non-governmental organisation or advocacy
- ☐ Processing or packaging
- ☐ Food safety
- ☐ Agricultural economics research institute
- ☐ Retail or distribution
- ☐ Other, please specify: \_\_\_\_\_

End of Block: Business level questions

---

Start of Block: Consumer level questions

*Display This Question:*

*If Which of the following best describes you? = Consumer or consumer representative*

Q31 Which of the following best describes you?

- ☐ Consumer body representative
- ☐ Consumer research agency representatives
- ☐ Expert in consumer behaviour and choice
- ☐ Individual
- ☐ NGO with a focus on consumer-level concerns, such as consumer awareness campaigns
- ☐ Other, please specify: \_\_\_\_\_



---

Page Break



*Display This Question:*

*If Which of the following best describes you? = Consumer or consumer representative*



Q32 Which country do you primarily work in?

- ☐ Austria
- ☐ Belgium
- ☐ Bulgaria
- ☐ Croatia
- ☐ Cyprus
- ☐ Czech Republic
- ☐ Denmark
- ☐ Estonia
- ☐ Finland
- ☐ France
- ☐ Germany
- ☐ Greece
- ☐ Hungary
- ☐ Iceland
- ☐ Ireland
- ☐ Italy
- ☐ Latvia
- ☐ Lithuania
- ☐ Luxembourg
- ☐ Malta
- ☐ Montenegro



- ☐ Netherlands
- ☐ Norway
- ☐ Poland
- ☐ Portugal
- ☐ Romania
- ☐ Slovakia
- ☐ Slovenia
- ☐ Spain
- ☐ Sweden
- ☐ Switzerland
- ☐ United Kingdom
- ☐ Other, please specify: \_\_\_\_\_

---

Page Break \_\_\_\_\_



*Display This Question:*

*If Which of the following best describes you? = Consumer or consumer representative*

Q33 Which of the following best describes the company or organisation you work for?

- ☐ NGO
- ☐ Consumer representation group
- ☐ Consumer research agency
- ☐ Research institute investigating consumer behaviour and choice
- ☐ Other, please specify: \_\_\_\_\_
- ☐ Not applicable: I am an individual, completing this survey in my capacity as a consumer

End of Block: Consumer level questions

---

Start of Block: Plant Scientist questions

*Display This Question:*

*If Which of the following best describes you? = Plant scientist*

Q40 Which of the following best describes the company or organisation you work for?

- ☐ University
- ☐ Public research institute
- ☐ Private research institute
- ☐ NGO
- ☐ Other, please specify: \_\_\_\_\_

---

Page Break



*Display This Question:*

*If Which of the following best describes you? = Plant scientist*





Q34 Which crops do you primarily work with/on? (choose up to 5)

- ☐ Barley
- ☐ Carrots
- ☐ Grain maize and corn-cob mix
- ☐ Grapes
- ☐ Oats
- ☐ Olives
- ☐ Onions
- ☐ Potatoes
- ☐ Rape and turnip rape seeds
- ☐ Rice
- ☐ Rye and maslin
- ☐ Sorghum
- ☐ Soya
- ☐ Spelt
- ☐ Sugar beet
- ☐ Sunflower seeds
- ☐ Tomatoes





☐ Triticale

☐ Wheat

☐ Other, please specify: \_\_\_\_\_

☐ Not applicable

---

Page Break



*Display This Question:*

*If Which of the following best describes you? = Plant scientist*



Q35 Which country do you primarily work in?

- ☐ Austria
- ☐ Belgium
- ☐ Bulgaria
- ☐ Croatia
- ☐ Cyprus
- ☐ Czech Republic
- ☐ Denmark
- ☐ Estonia
- ☐ Finland
- ☐ France
- ☐ Germany
- ☐ Greece
- ☐ Hungary
- ☐ Iceland
- ☐ Ireland
- ☐ Italy
- ☐ Latvia
- ☐ Lithuania
- ☐ Luxembourg
- ☐ Malta
- ☐ Montenegro



- ☐ Netherlands
- ☐ Norway
- ☐ Poland
- ☐ Portugal
- ☐ Romania
- ☐ Slovakia
- ☐ Slovenia
- ☐ Spain
- ☐ Sweden
- ☐ Switzerland
- ☐ United Kingdom
- ☐ Other, please specify: \_\_\_\_\_

---

Page Break \_\_\_\_\_



Display This Question:

*If Which of the following best describes you? = Plant scientist*

Q77 Are you directly involved with the CropBooster-P project?

- ☐ Yes
- ☐ No
- ☐ Other, please specify: \_\_\_\_\_

End of Block: Plant Scientist questions

Start of Block: Thank you



Q74 Any other comments?

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Q76 If you would like to receive information about the results of this project directly, please leave your email address below. Your input will always remain anonymous.

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Q75 Thank you for taking the time to complete this survey. **Please share this survey!** We are looking for as many responses and views on these issues as possible, so that we can provide useful data to the EU about priorities for future research in crop breeding. Please consider sharing this survey with colleagues, friends, and connections anywhere in Europe – [a sharing link to the survey is available here](#), and a QR code is



below. The survey is available in [English](#), [French](#), and [German](#). Thank you for your support. QR code link to the survey

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#### Q91 Browser Meta Info

Browser  
Version  
Operating System  
Screen Resolution  
Flash Version  
Java Support  
User Agent

End of Block: Thank you

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