THE SUSCROP EXPERT WORKSHOP 2
MAY 10 & 11 2023, Berlin

REPORT

INTRODUCTION & WORKSHOP METHODOLOGY

SusCrop is an ERA-NET, funded under H2020, that started in 2018 and which will finish in 2023. The ERA-NET set out to achieve alignment of current European, national and regional activities in crop research to meet societal challenges on food security. As part of SusCrop activities, extensive work was done to assess current research on sustainable crop production in Europe and to look forward to future research needs. This began with a mapping of past and present related European and international research actions and a research gap analysis. This was followed by the organisation of a first expert workshop to begin the elaboration of a (set of) focus area(s) for future research on sustainable crop production. This first workshop was help in November 2022 and focused on **protein crops**[1], primarily for food but also including feed. The focus was on production (crop improvement and cultivation), but taking into account the value chain. The first workshop identified the following gaps that need to be addressed in the coming years:

- Crop improvement (to balance crop management and processing)
- Niche crops – in this workshop protein crops - (to balance staple crops)
- Nutritional security (to complement yield)
- Resistance / tolerance to combined abiotic and biotic stresses (to balance in depth work on abiotic, biotic stress resistance)
- Research Infrastructures
- Policy: legislation (enable the use of NGTs in Europe), public procurement (for niche crops – in this workshop protein crops)

In this second workshop, experts and stakeholders (Annex 1) were invited to gather to further identify and prioritise research gaps and knowledge needs concerning two focus areas among the ones identified in the first workshop:

1- Combined biotic and abiotic stress: resistance/tolerance and trade-offs
2- Nutritional quality of crops for food

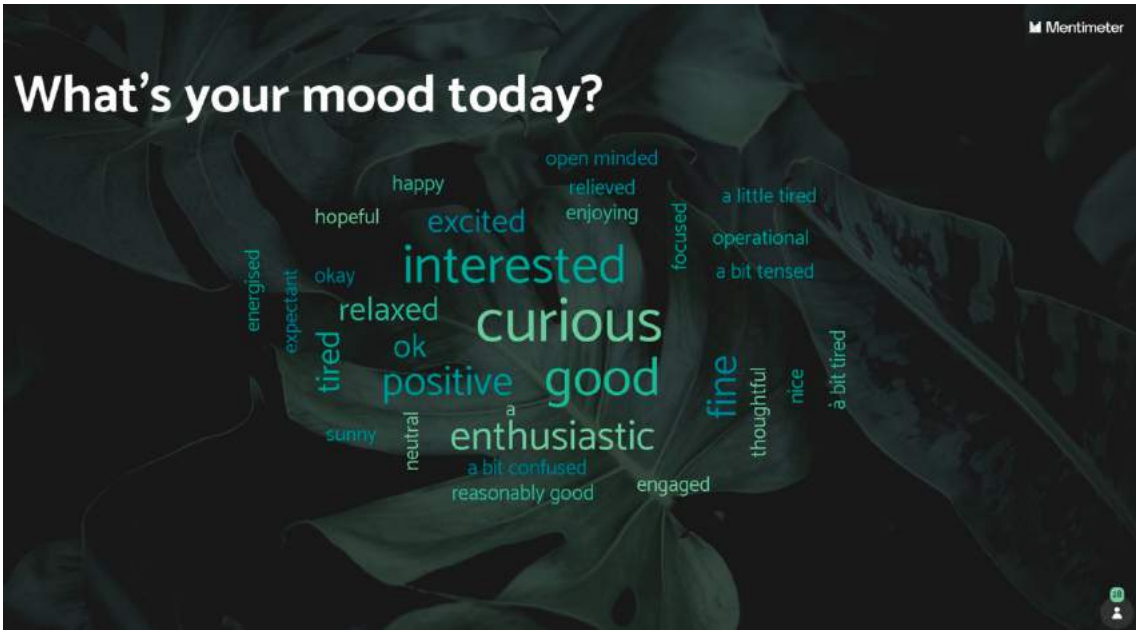
The work was organised in several steps: after a short introduction and icebreaker, we had two sets of presentations (Annex 2) : one from the scientific point of view on key research gaps and interests related to the above focus areas, and the second from the stakeholder perspective on priority knowledge needs. Group discussions then allowed for validating and identifying further topics at the crossroads of these two perspectives. Participants were invited to "wear the shoes" of stakeholders such as farmers to ensure this perspective was fully considered. These topics were reported back and grouped under main research themes; they then served as the basis for a next step to discuss and draft potential research questions for each theme, remembering the two framing principles: real lack of research and contribution to sustainability.

The outputs of this workshop, together with the previous one and the preparatory analyses, are expected to give rise to a white paper and will also feed into, among others, the FACCE-JPI Strategic Research Agenda (SRA) and be available as advice to Member States (SCAR) and to the European Commission.

[1] We use the term protein crops here in a large sense, referring to proteins coming from plants (but not algae) and therefore including e.g. grasses.

Table 1 : Participants expectations

Learn about other views
Contribute to a collaborative funding proposal
Reaching clear recommendations on proposals
New ideas
I don't know yet
Consensus on priorities
Insight from stakeholders that I have had little interaction with previously
Some insight into which direction the research interest will go
Good discussions, new connections, new ideas
Good discussion
Positive about next steps
Get an idea about future research priorities for protein crops
Hear the views from each participant
To learn a lot and gain new insights
Learn more about the gaps from the different viewing points
Some priorities for research that are specific and readily fundable
No defined expectation
Positive, new ideas
Get new information/views on sustainable crop production
Reinforcing the importance of nutritional quality AND disease in legumes as sustainable crops
Good discussion
More specific recommendations developed
New ideas
Priorities in research
Good discussion
Contribution to next research programmes, but who will receive the white paper?
Specific outcomes for potential actions
Important research gaps, good discussions
New insights and reality checks on needs and expectations from research to stakeholders and back



WORKSHOP RESULTS

RESEARCH QUESTIONS (SEE ALSO ANNEX 3)

TOPIC 1: MIXED CROPPING SYSTEMS AND LAND MANAGEMENT + POST-PRODUCTION CHALLENGES FOR FARMERS

This research question focused on issues related to crop management at the farm level as major challenges for farmers, in particular to have proper knowledge on mixed crops combining niche crops with stable crops.

Research should explore these mixed crops starting with one or a small number of minor/emerging crops. The studies need to investigate diversification for optimisation of yield in different conditions, including various land uses, input reduction, and impact on farmers' income. This research should start at small scale (1-2 species) and explore how to include legumes in crop rotations.

Research needs to build on examples (agroforestry) of mixed/strip cropping, multipurpose crops, and catch crops.

Research should also bring insights on the implications for production and value chains, as well as financial/risk aspects and benefits (relations with market).

For a given biogeographic region, research would provide information on:

- What mixes are best fitted
- What practices including harvesting, biofertiliser, biorefineries for side streams should be implemented
- What equipment is necessary

To build this knowledge basis by region, there is a need to test management practices in different regions and to ensure best practices are shared across regions so research efforts should also support the establishment of a network project to share data and knowledge.

TOPIC 2: OPTIMISING NUTRITIONAL VALUE AND HEALTH BENEFITS WITH A SPECIAL FOCUS ON NICHE CROPS

Research should focus on:

a. Developing "-omics" and researching metabolic pathways to identify compounds beneficial for human nutrition, such as proteins, vitamins, micronutrients (including phytonutrients) and fibres in niche crops. Then further increase nutritious compounds using the best means, for example genetic improvement and crop management.One aspect could be to either analyse a larger group of niche crops to find some candidates or to focus on 1-3 niche crops with indicated beneficial/non-beneficial compounds from previous research.

b. Investigating bioavailability of beneficial as well as non-beneficial nutrients for human and animal health. Then explore how to change bioavailability to increase beneficial and decrease non-beneficial compounds for human / animal digestion.

c. Verifying health benefits with research focusing on investigating whether there is increased beneficial and / or decreased antinutrients or non-beneficial compounds. This could make use of compounds for humans (clinical trials) and / or animals. Research should also take in consideration that target nutrients (beneficial and non-beneficial) can be in the same plant or different plants but combined in the product/diet.

As a note: a health claim for a defined compound supported by public funds can benefit all breeders/farmers/processors/retailers and consumers to develop many niche crops with this compound.

Link efforts in the above research priorities (a-c) to have complete pathways for improvement of beneficial compounds and decrease of non-beneficial ones.

- Investigating the role of microbiomes (in crop, soil, humans, animals) for nutritional quality in crops and bioavailability in humans and animals.

TOPIC 3: MULTI-STRESS RESISTANCE FOR STABLE YIELD

An important research question is the investigation of multi-stress resistance and this requires first mapping then modelling of the matrix: "crop-region-climate". Once this matrix is

documented it would be possible to project it into future climate scenarios looking specifically at the changes by crop (niche, minor crop) and by type of stress. This research should also allow for a global monitoring of emerging pathogens and for prediction of climatic stressors in different European regions for the future.

An important research area will be to translate and test these scenarios in the field and real conditions to investigate:

a. How do (emerging crops) plants respond to stresses (biotic/abiotic stress factors including competition). This should cover all pests and abiotic stresses.
b. How to improve basal immunity
c. How to predict intensity and length of drought in different areas of Europe and which crops are best fitted. Research should also explore Improvement of suited crops for stress response.
    - For example, protein crops in northern Europe
d. The epigenetics of stress memory (genetics of epigenetic memory)
e. The best processes for global monitoring of pathogens

TOPIC 4: TOOLBOX FOR (NEW) CROPS

As a cross-cutting research priority, it is critical to develop a toolbox for (new) emerging crops, including:

a. Development of fundamental tools at the research level for minor crops: genomes, markers + mapping populations + seeds/seedbanks especially with vouchers of sequenced accessions as well as transformation
b. Efficient pathways to move from lab models to real life production (including microbiome)
c. Understanding the value chain for minor crops beyond farmgate, including policy and society (this feeds into a and b)

TOPIC 5: ECONOMIC FEASIBILITY FOR NEW CROPS AND SOCIAL RESEARCH IN SUPPORT OF THE VALUE CHAIN

To support the transition to new/emerging crops, research should provide feasibility studies on how to integrate new/emerging crops into value chains (combining socio-economics, sustainability etc.). Research should explore for example the levers that promote economic feasibility of niche crops, the barriers and risk management at farm level, as well as the impact of subsidies versus risk capital investment, incentives and barriers due to policy frameworks (are they appropriate/dynamic) and in particular how to harmonise breeding policy/Common breeding policy.

In terms of the value chain, research would need to explore the current levers and bottlenecks for all actors in the value chain to support a transition to niche crops and which measures could help overcome these barriers (for example how to make transition desirable for farmers/what are the incentives and barriers to overcome?).

A particular focus of research should be on the potential incentives to change the mindset of consumers and society at large. Research would need to focus on how to ensure long-term consumer commitment to the transition to new crops based on current consumer

behavioural science: how could niche crops be made attractive for consumers? (for example, local versus regional “major” crops, reduction of allergenic compounds (intolerances), “consumer champion” group?)

CONCLUSIONS

The participants have identified five research areas as priorities and provided for each some very concrete description of research questions.
The main areas are:

a. Mixed crops and support to farmers for land management and post-production
b. Multi-stress resistance of niche/emerging crops and how to improve it
c. Nutritional and health quality of niche / emerging crops and how to improve it
d. Associated toolbox from genomics to value chain
e. Economic feasibility of cultivating / producing niche / emerging crops at farm level and better understanding of bottlenecks and ways to overcome them in the value chain

ANNEXES

ANNEX 1: LIST OF PARTICIPANTS

First name	Last name	Organisation	Country	Participation
Stig	Andersen	Aarhus University	Denmark	Virtually
Estelle	Balian	Facilitation- ALESOPI	FR	In person
Sylvia	Bluemel	AGES	Austria	In person
Ophélie	Bonnet	INRAE	France	In person
Christian	Breuer	FZJ	Germany	In person
Mark	Chapman	University of Southampton	United Kingdom	In person
Anne	Damoiseaux	Facilitation- Ansor Sprl	France	In person
Audiane	Duteil	INRAE	France	In person
Pablo	Gómez Grande	INIA-CSIC	Spain	In person
Joël	Groeneveld	F.R.S.-FNRS	Belgium	In person
Isabelle	Hippolyte	ANR	France	In person
Rocío	Lansac	INIA-CSIC	Spain	In person
Stefanie	Margraf	JÜLICH	Germany	In person
Josette	Masle	The Australian National University	Australia	Virtually
Heather	McKhann	INRAE	France	In person
Linn	Meilvang	GUDP	Danmark	In person
Karin	Metzlaff	EPSO	Belgium	In person
Amrit	Nanda	Plants for the Future ETP	Belgium	In person
Anne-Maria	Pajari	University of Helsinki	Finland	In person

Pirjo	Peltonen Sainio	LUKE	Finland	Virtually
Katia	Petroni	Università degli Studi di Milano	Italia	Virtually
Johannes	Pfeifer	BLE	Germany	In person
Nina	Radl	BML	Austria	In person
Baiba	Rivža	LAAFS	Latvia	In person
Elena	Rodríguez-Valín	INIA-CSIC	Spain	In person
Angelo	Santino	CNR	Italy	In person
Sanu	Sanu Arora	John Innes Centre	United Kingdom	Virtually
Yolanda	Sanz	AEI Spain	Spain	Virtually
Emre	Sari	TÜBİTAK	Turkey	Virtually
Alan	Schulman	LUKE & University of Helsinki	Finland	In person
Mateusz	Skutnik	NCBR	Poland	In person
Carlota	Vaz Patto	ITQB NOVA	Portugal	Virtually
Silke	Wieckhorst	KWS SAAT SE & Co. KGaA	Germany	In person
Marta	Wilton Vasconcelos	Universidade Católica Portuguesa	Portugal	Virtually
Katja	Witzel	IGZ	Germany	In person

ANNEX 2 WORKSHOP AGENDA

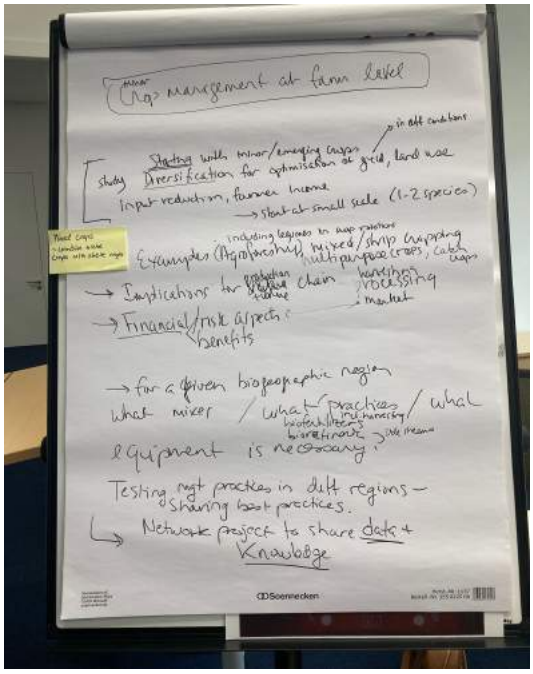
THE SUSCROP EXPERT WORKSHOP 2
Day 1

Time	Length		Title	Description
12:00	30m		**Welcome Lunch**	
13:00	20m		**Introduction Background and Objectives**	
13:20	20m		**Getting to know participants- Ice breaker**	
Presentations and focus group discussion 1: Research gaps				
13:40	10m		**Introduction to the presentations/focus conversation session**	
13:50	30m		**State of the art presentations on current knowledge gaps related to the focus areas**	***Biotic and Abiotic stresses presentation*** *(Alan Schulman, LUKE & Univ. of Helsinki)* ***Nutritional quality of crops*** *(Angelo Santino, Italian National Research Council,Institute of Sciences of Food Production, C.N.R., Unit of Lecce)*
14:20	20m		**Focused conversations: group discussion**	
14:40	*10m*		***Coffee break***	
Presentations and focus group discussion 2: perspectives of stakeholders				
14:50	30m		**Perspectives of farmers and other stakeholders on current knowledge needs**	**Perspective of the breeding Sector on knowledge needs** (*Silke Wieckhorst, KWS-KGaA, DEEI)*
15:20	30m		**Focused conversations: group discussion**	
15:50	*10m*		***Coffee break***	
16:00	40m		**Reporting from the two sessions of group discussions**	
16:40	10m		**Evaluation of the day and introduction to next day process**	
16:50	**END OF DAY 1**			
19:30	***SOCIAL DINNER –***			

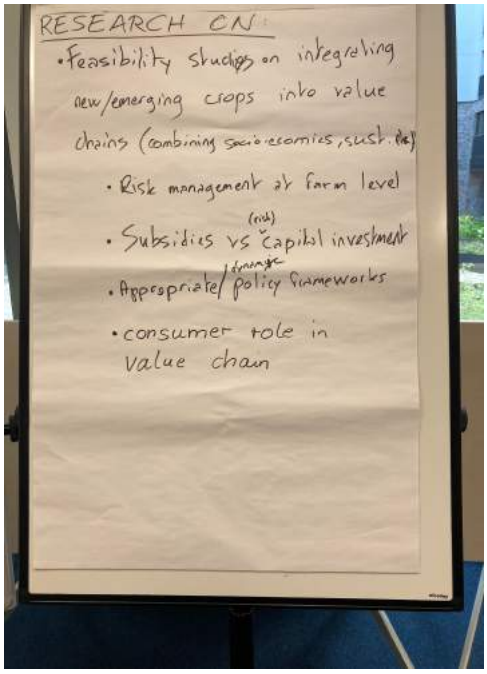
THE SUSCROP EXPERT WORKSHOP 2
DAY 2

ime	Length		Title	Description
9:00	10m		**Programme Day 2**	
9:10	40m		**Prioritisation of the identified research needs**	
9:50	15m		**Introduction and preparation of the break-out group session on priorities**	
0:05	*15m*		***Coffee break***	
xploring more in details the top 5 research priorities from previous session				
0:20	40m		**Break-out group session 1** */ What specific sub-topics should be tackled in relation to this research priorities*	
1:00	40m		**Break-out group session 2 /** *How do you understand these sub-topics, how would you clarify them? What is missing?*	
1:40	15m		**Group rapporteurs prepare a summary paper board**	
1:55	45m		**Reporting from the groups**	
2:40	20m		**Evaluation & Closing/next steps**	
3:00	***END OF THE WORSHOP AND LUNCH***			

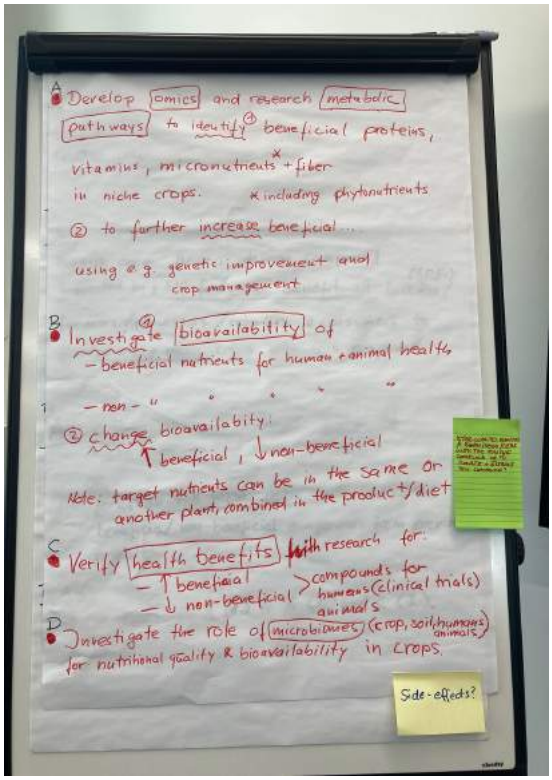
ANNEX 3: DISCUSSION POSTERS



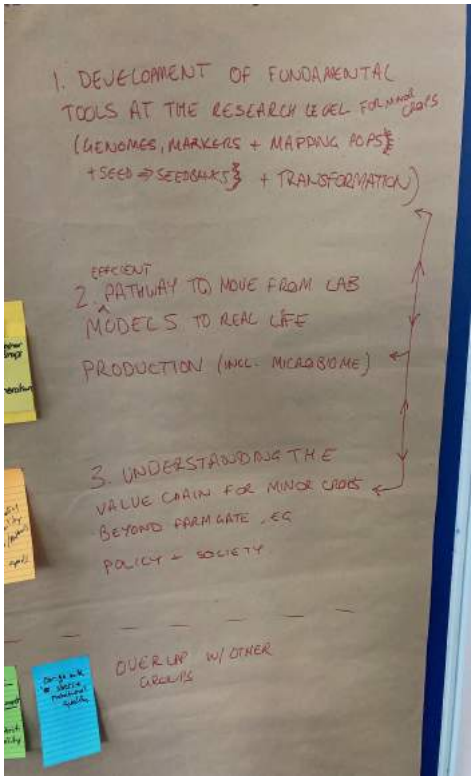
Group 1: Mixed cropping systems and Land management + Post-production challenges for farmers



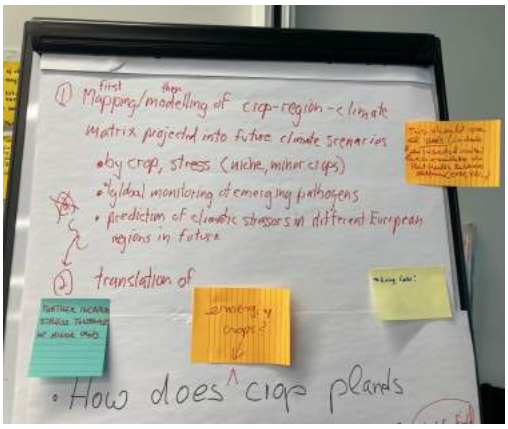
Group 2: Economic feasibility for new crops



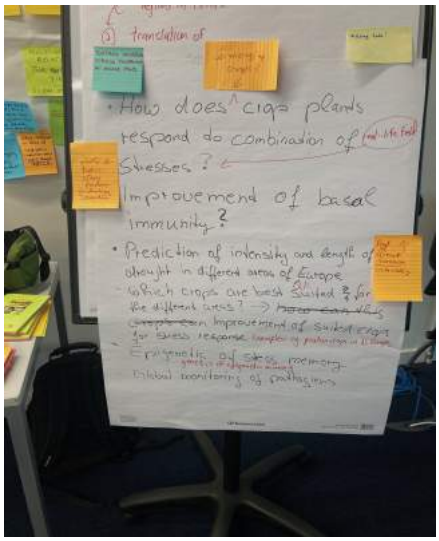
Group 3: Optimising nutritional value and health benefits



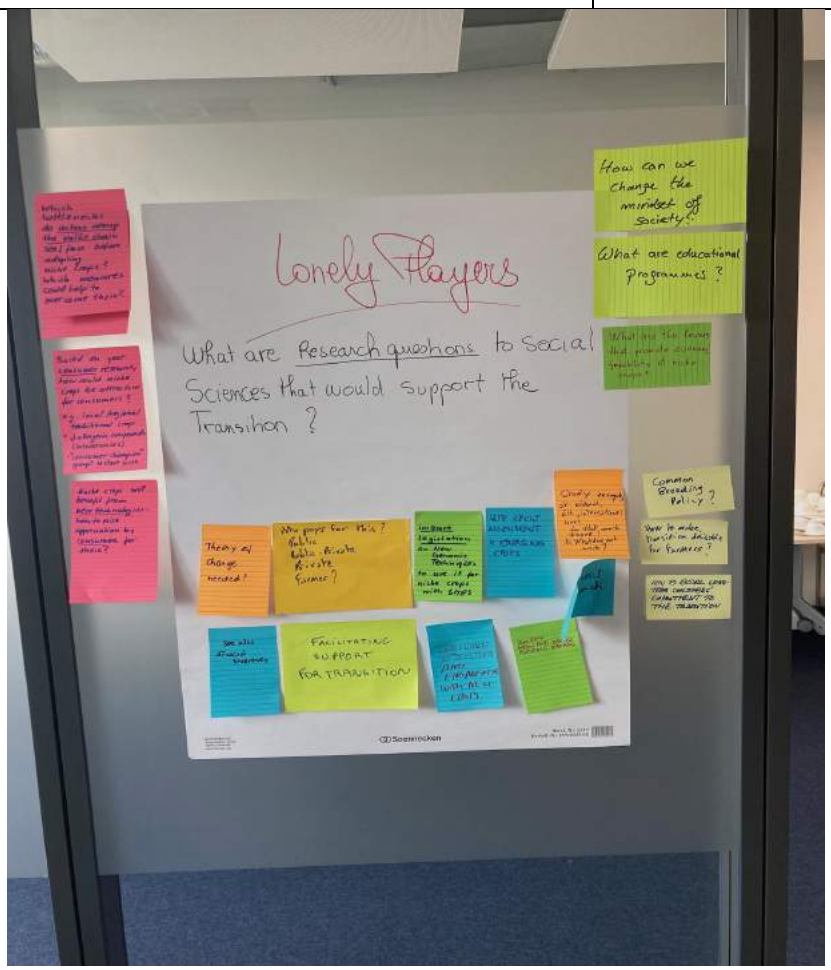
Group 4: Toolbox for (new) crops



Group 5: Multi-stress resistance for stable yield part 1



Group 5 Multi-stress resistance for stable yield Part 2



Plenary discussion results on research questions to social sciences