



CropBooster-P Workshop of WP4

N-1&N-4: Improving specialized metabolite contents for improving animal and plant health and agriculture sustainability

Coordinated by Massimiliano Corso & Loic Lepiniec & Emmanuel Gaquerel

Experts

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[Alain Tissier](#) (IPB, Halle)

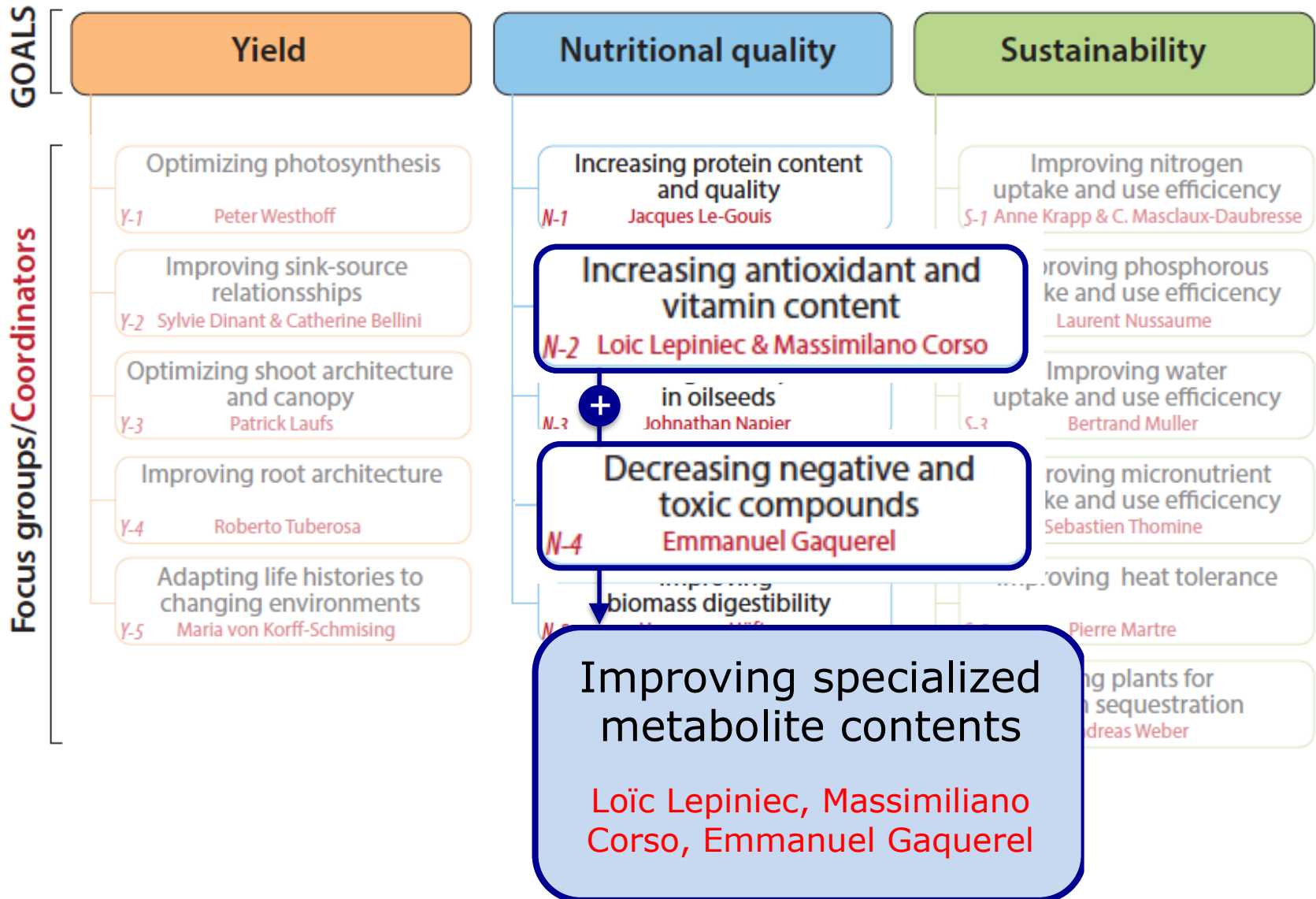
[Frank Van Breusegem](#) (VIB, Ghent)

[Dominique Van Der Straeten](#) (Ghent University)

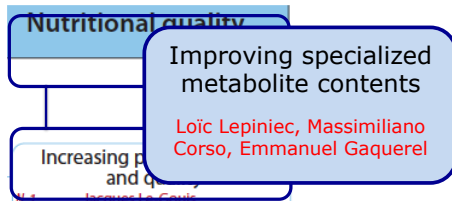
[Nathalie Verbruggen](#) (ULB, Bruxelles)

2-sided effects of small molecules on nutritional quality

List of “Focus Groups”:

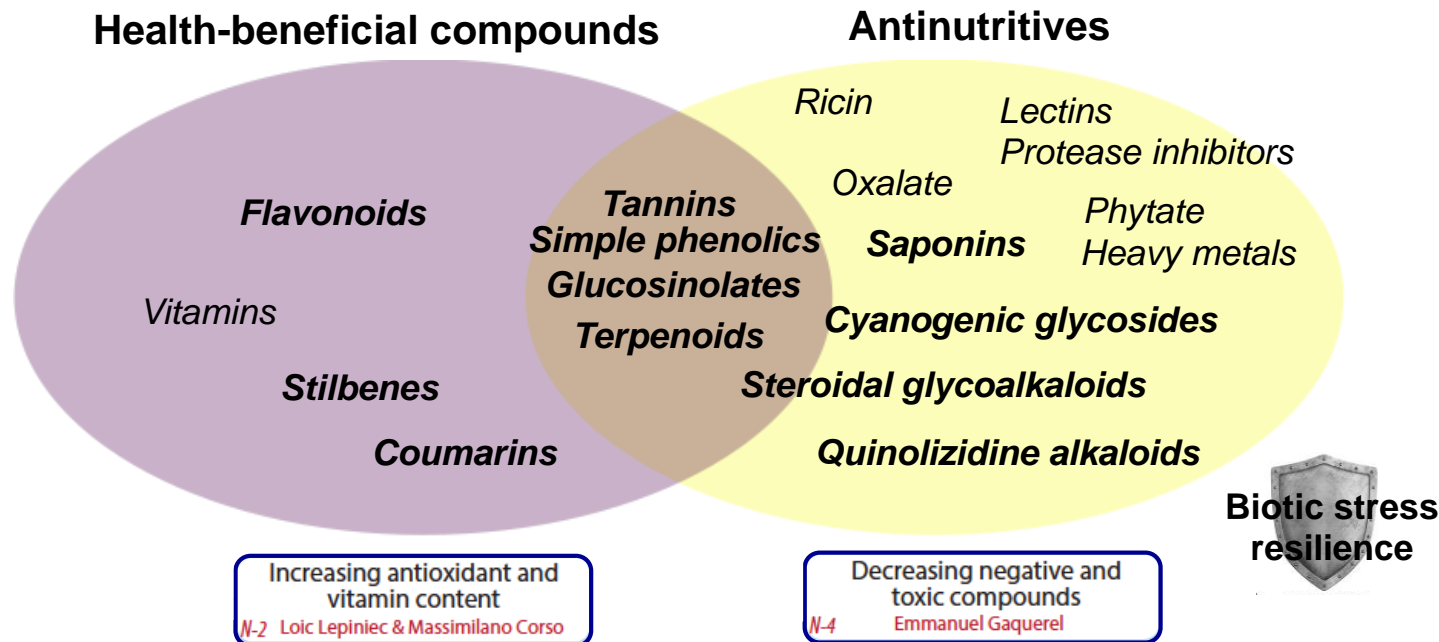


Spec. metabolites (SMs) have contrasting effects on nutritional quality

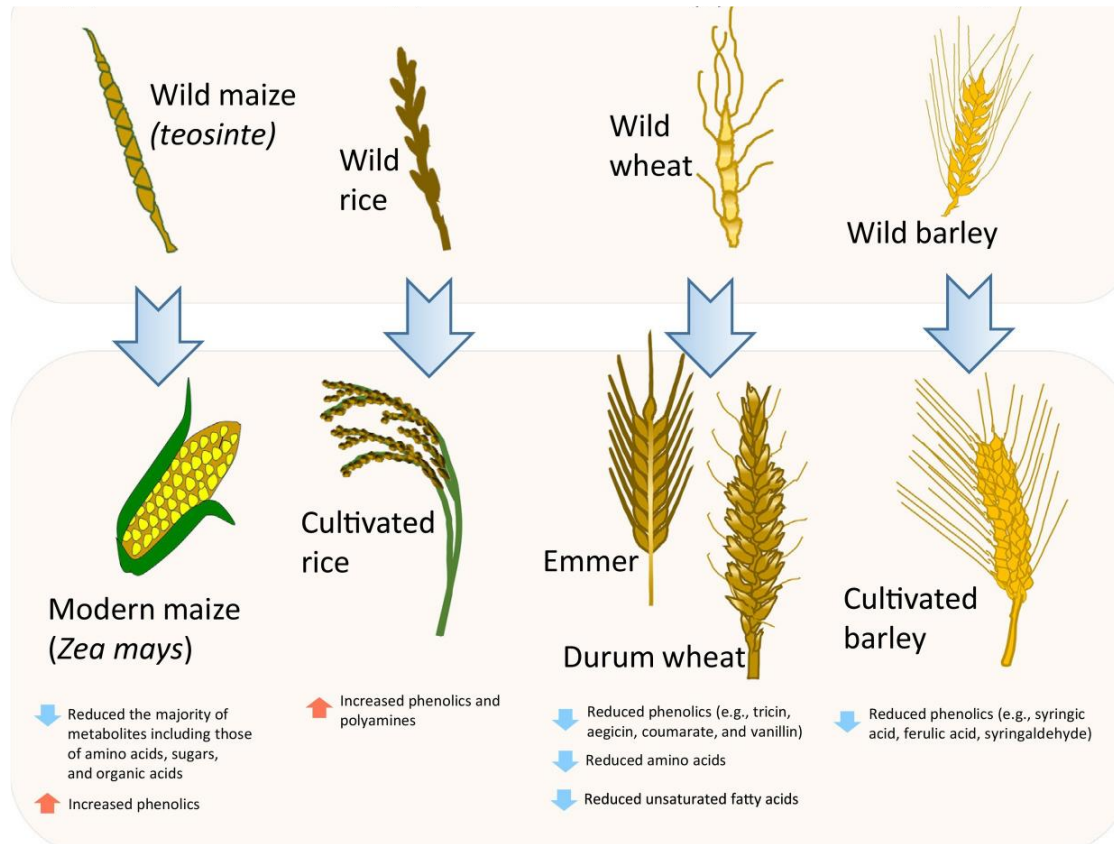


- Extremely **diverse** in chemical structures and **phylogenetic distributions**
- Not-directly essential growth/energy-related processes but acting **stress resilience chemical shields**
- **Biosynthesis and regulation much less understood** than that of central C metabolism

Accumulation of beneficial SMs is a desirable trait, but it can be counter-balanced by the presence of other SMs acting as antinutritional or toxic factors in edible parts of cultivated species



Content of beneficial SM and ANFs in plants was altered by domestication



Alseikh et al., 2021. Domestication of Crop Metabolomes: Desired and Unintended Consequences. Trends in Plant Sciences

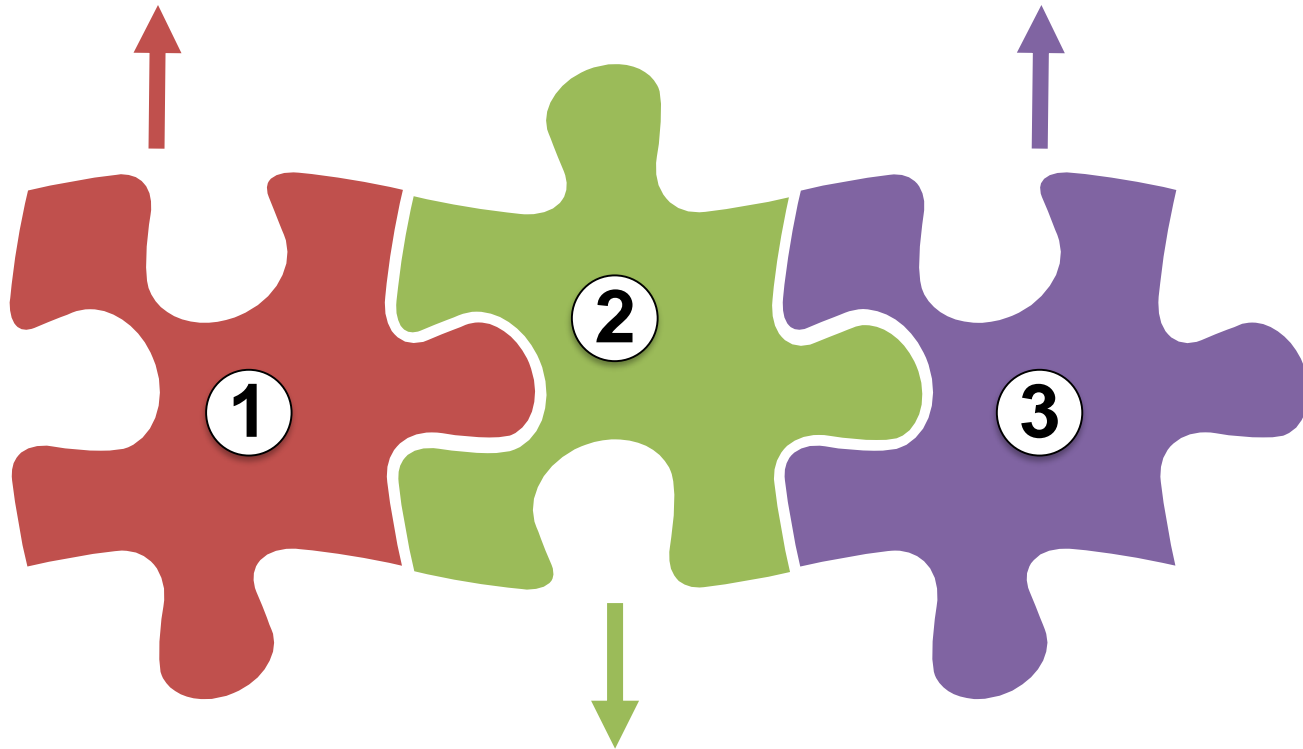
+

Conventional breeding (ex. selection low content cyanogenic glycoside Cassava)
RNAi-based strategies fo ANF removal (ex removal of solanine in potato lines)

Priority areas and actions points

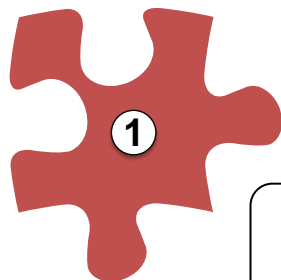
SM pathway characterization
*Exploiting plant **chemodiversity***

Characterization of SM multifaceted roles



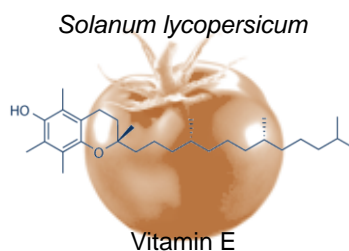
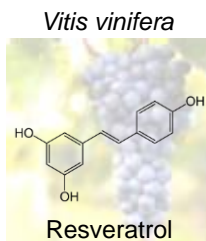
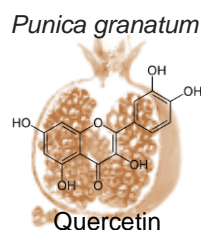
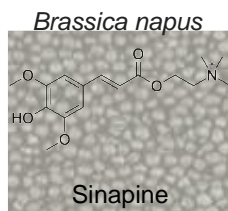
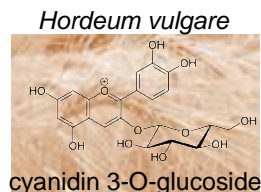
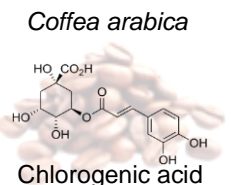
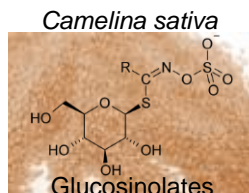
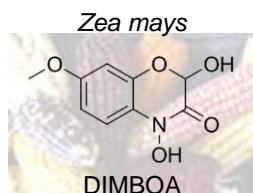
***Technological
developments for SM content
modulation***

Priority areas and actions points

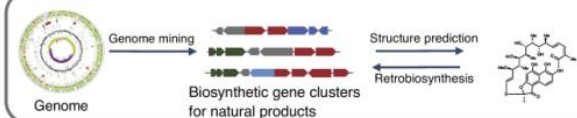


Discovery and characterization of high-priority SM metabolic pathways

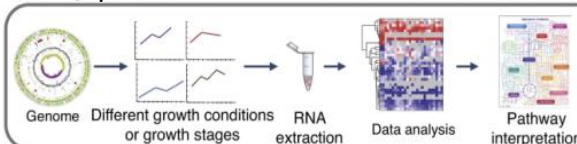
SM diversity



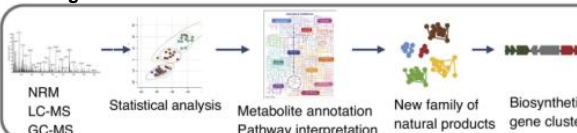
Genomics and Epigenomics



Transcriptomics



Untargeted Metabolomics

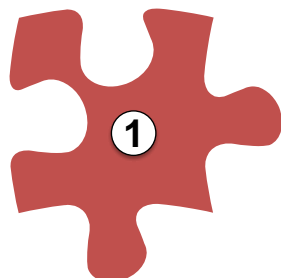


Empowered by multi-omics approaches

in high-priority crops, orphan crops and wild species exhibiting interesting chemodiversity

Modified from A. Boualem, SPS 2019 Meeting

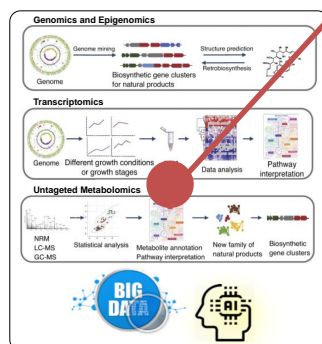
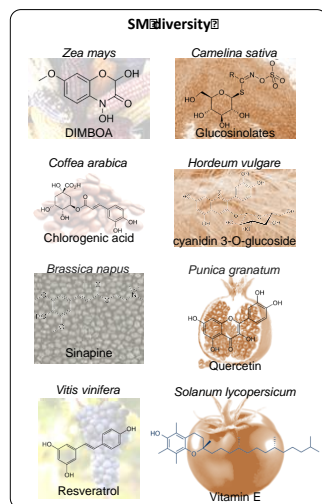
Priority areas and actions points



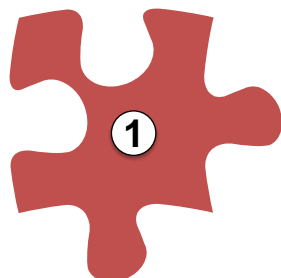
Discovery and characterization of high-priority SM metabolic pathways

Priorities

- 1. Identification of key genes (biosynthesis, transport, regulatory, stability, bioactivity) in high-priority SM pathways.**



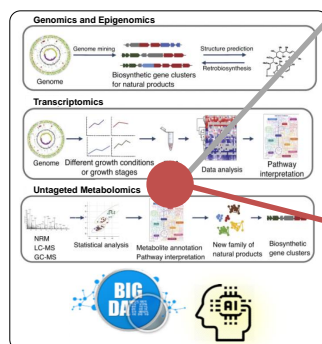
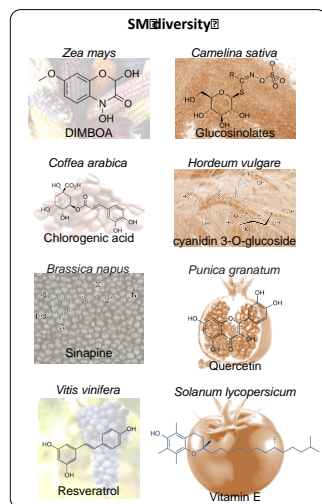
Priority areas and actions points



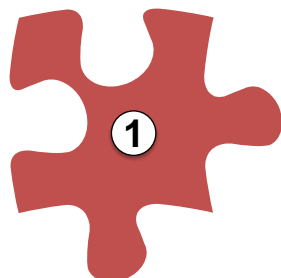
Discovery and characterization of high-priority SM metabolic pathways

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1. Identification of key genes (biosynthesis, transport, regulatory, stability, bioactivity) in high-priority SM pathways.
2. Characterization of environmental and developmental regulations of SM pathways (and underlying regulatory mechanisms).



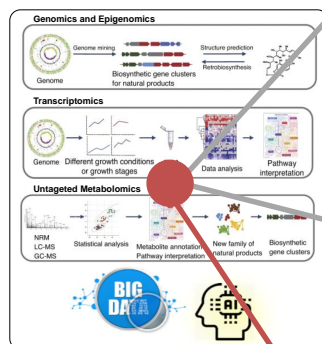
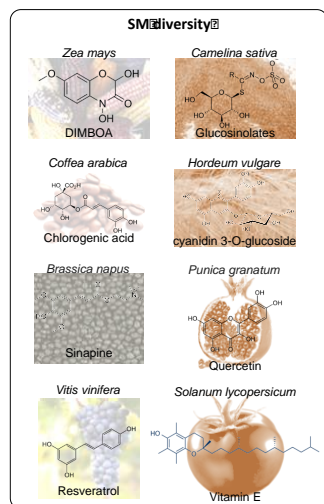
Priority areas and actions points



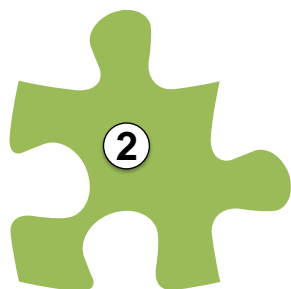
Discovery and characterization of high-priority SM metabolic pathways

Priorities

1. Identification of key genes (biosynthesis, transport, regulatory, stability, bioactivity) in high-priority SM pathways.
2. Characterization of environmental and developmental regulations of SM pathways (and underlying regulatory mechanisms).
3. Exploring the natural chemodiversity existing in crops and their wild relatives at both metabolome and genome levels.



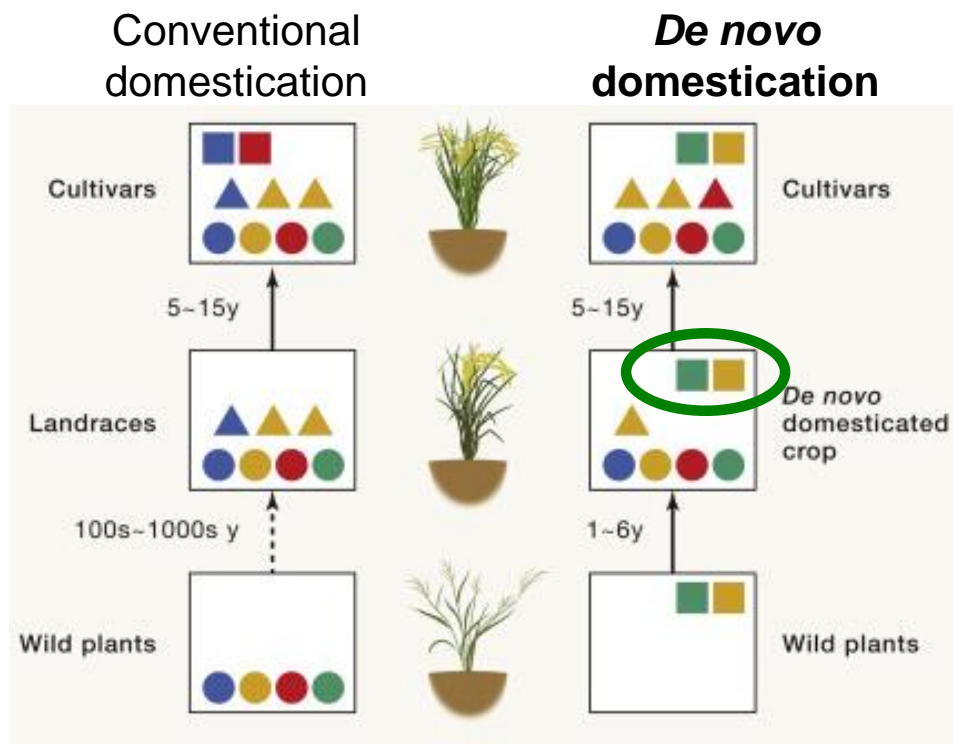
Priority areas and actions points



Developing new tools for breeding crops with desired SM contents

Priorities

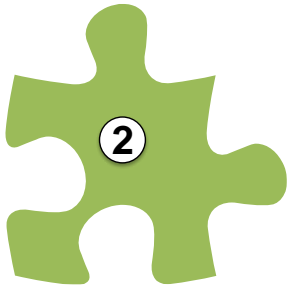
1. ***De novo* domestication of wild plants with interesting metabolic characteristics** (powerful solution for designing ideal crops with the optimal nutritional balance)



Interesting SM traits/genes

Modified from Zhu and Zhu, 2021.
Cell 184(5):1133-1134

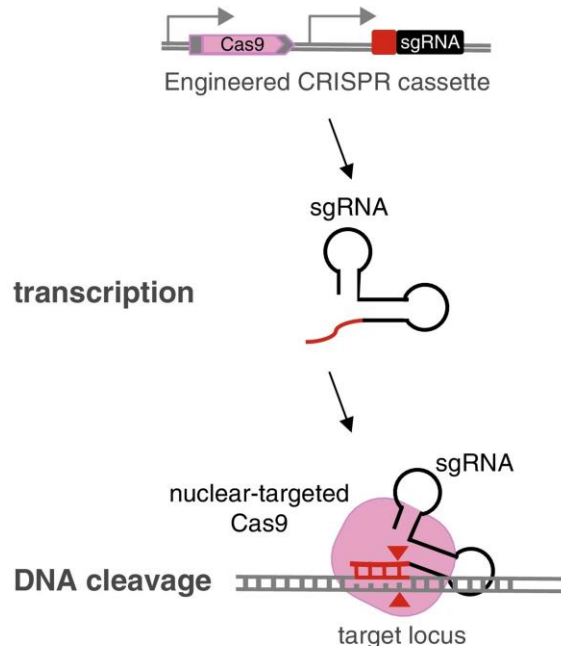
Priority areas and actions points



Developing new tools for breeding crops with desired SM contents

Priorities

1. *De novo* domestication of wild plants
2. **Precision genome-editing** for fine-tuned SM contents minimizing pleiotropic effects on crop performance



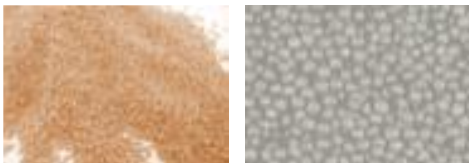
- **fine-tuned targeted promoter editing** to redirect or boost SMs pathways in nutritious/consumed tissues
- **SM transport alteration** to avoid antinutritive SM build-up consumed tissues
- Optimize the **technology transfer efficiency** in underused varieties and orphan crops.

Priority areas and actions points

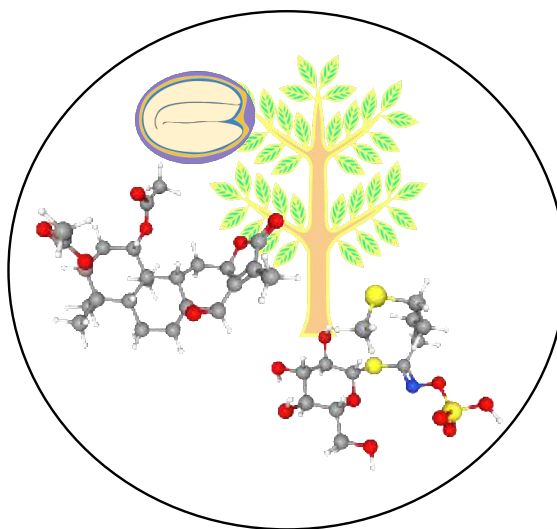
3

One SM, multiple functions and effects ?

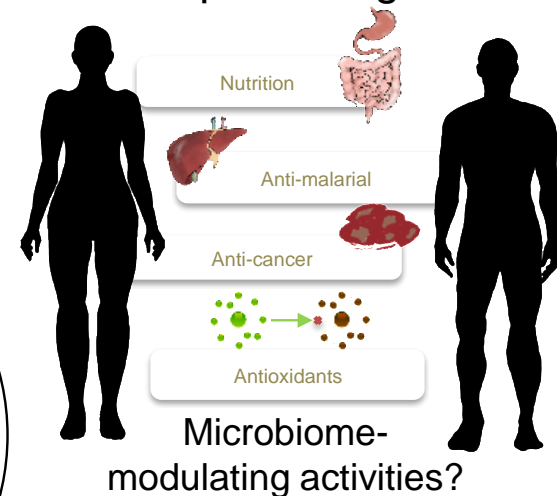
1. Pleiotropic effects on oil and protein in seeds



Priorities



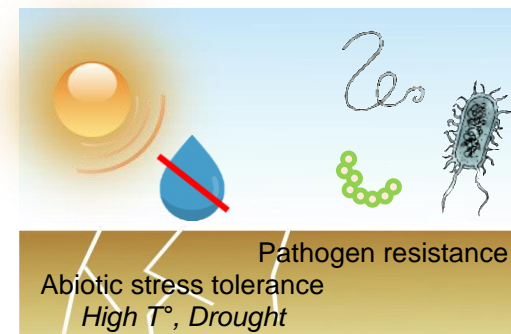
2. Health-promoting effects



3. Interplay between SM content and organoleptic quality

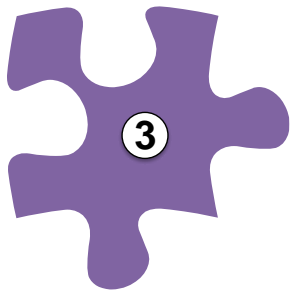


4. SM in plant-environment interaction

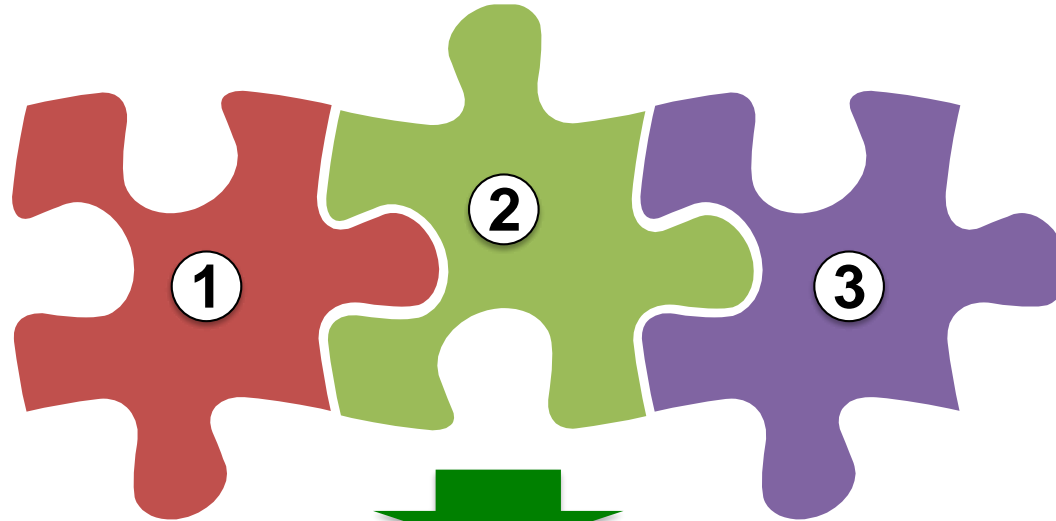


Impact of global climate change?

Priority areas and actions points



*One SM, multiple functions and effects ?
... multiple value markets*



Medecine



nutraceuticals



Dyes



Aromas



cosmetics/ Ess. oils



biopesticide



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