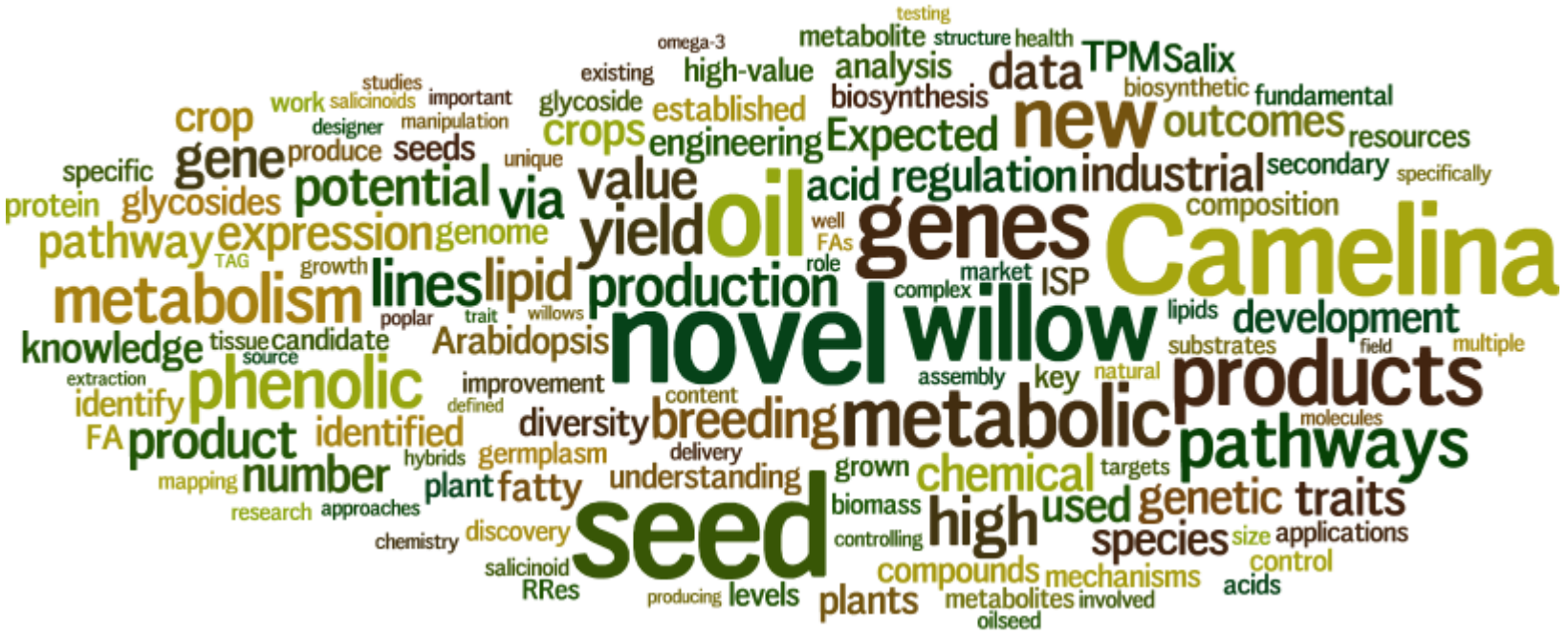
Tailoring Plant Metabolism for the Bioeconomy

- a BBSRC Institute Strategic Programme



BBSRC
bioscience for the future

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3 Science Portfolios address 6 Grand Challenges

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Superior Crops

Challenge 1
Accelerate improvements in yield, quality and resource efficiency of wheat and other crops

Challenge 2
Discover or design novel traits that improve the nutritional or industrial value of plants

Securing Productivity

Challenge 3
Monitor and forecast the spread of pests, weeds and diseases in real time

Challenge 4
Combine genetic, chemical, ecological & agronomic strategies for smart crop protection

Future Agri-Food Systems

Challenge 5
Enable the majority of farmers achieve at least 80% of the attainable potential

Challenge 6
Create crop and livestock systems with higher performance &, nutrient value but lower environmental impact

Institute Strategic Programmes map to Grand Challenges….

Tailoring Plant Metabolism- *strategic goals*

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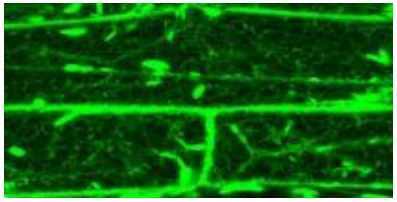
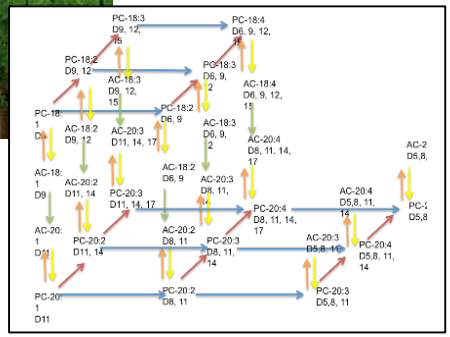
- To advance and exploit fundamental understanding of plant metabolism
- …to expand the value chains of existing crops
- …by delivering a portfolio of high value lipids, phenolic glycosides and plant germplasm
- “From metabolite to gene to field”





Tailoring Plant Metabolism- *work packages*

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ISP leader: Freddie Theodoulou
Deputy: Peter Eastmond

High value lipids for health and industry

Leader: Johnathan Napier
Deputy: Olga Sayanova

Gene/metabolite discovery; novel targets

Pathway elucidation & regulation

Platform development

Product delivery

Phenolic glycosides for health and industry

Leader: Mike Beale
Deputy: Jane Ward


Camelina metabolic engineering

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Blue skies → Strategic → P/o concept → Demo → **Market**

- Success story: “Fish oil” produced in plants- from gene to field.
- Impacts: academic, commercial, public engagement, policy
- Current challenge: predictive metabolic engineering
- New targets for the pipeline:

wax esters, structured triacylglycerols, novel fatty acids…

Discovery science in Camelina & Arabidopsis

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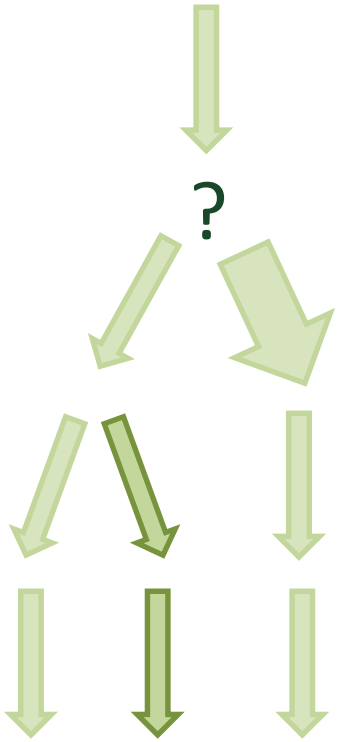
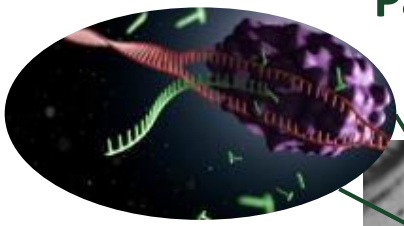
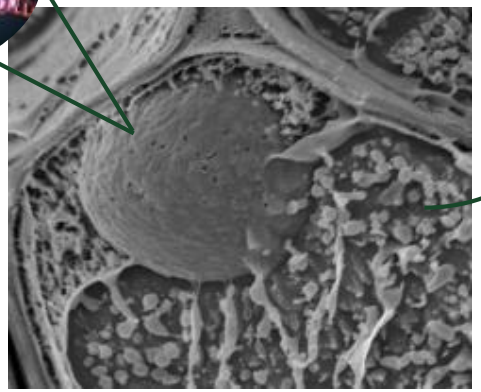
Pathway elucidation

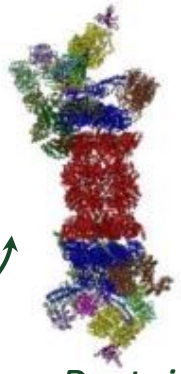


Pathway regulation

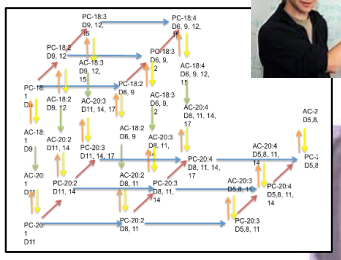


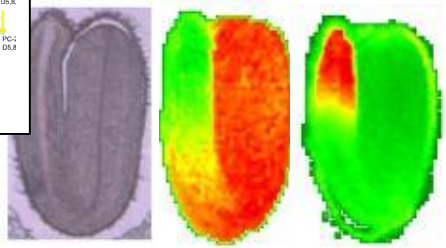
Transcription, RNA export

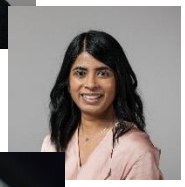




Protein degradation







Response to introduction of heterologous pathways

Product-precursor relationships

Current Brassica projects

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- RRes Fellowship: Improving lipid-related traits via TILLING (Smita Kurup & Fred Beaudoin)
  - Link to OREGIN V: impact of cuticular lipids on pest/pathogen interactions (Jon West & Sam Cook)

- BRAVO sLoLa: linking genotype to phenotype across multiple reproductive traits in *Brassica napus* and *B. oleracea* (Peter Eastmond & Smita Kurup)

- RIPR sLoLa: Renewable Industrial Products from Rapeseed (Fred Beaudoin)

GWAS, associative transcriptomics, time-resolved transcriptome; co-products

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Tailoring Plant Metabolism - *our platforms*

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Genetic improvement

"Predictive breeding"

Germplasm → Phenotyping → Genetics → Candidate genes → Validation → Delivery

Chassis improvement

Metabolic engineering

Candidate genes → Validation/ Transformation → Analysis → Scale-up; field → Regulation

"Predictive metabolic engineering"

Discovery science in willow & poplar

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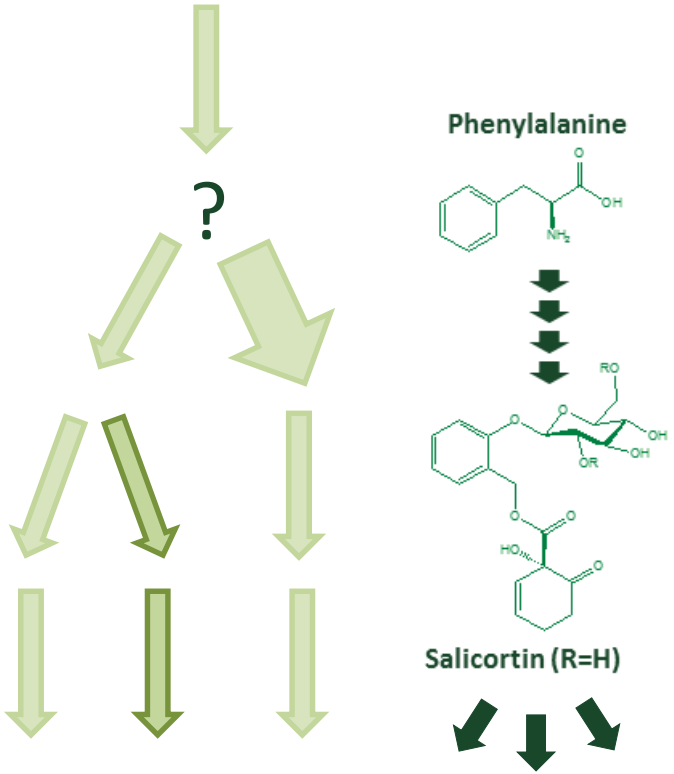
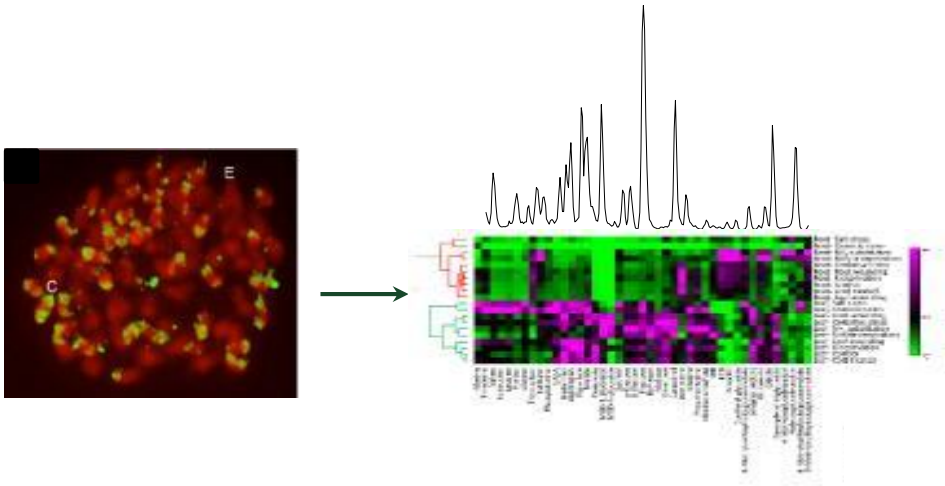
Pathway elucidation & regulation



Metabolic consequences of hybridisation



Highlight: Elucidating phenolic glycoside biosynthesis

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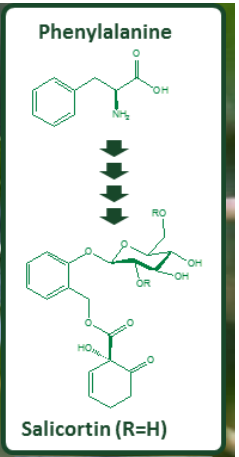
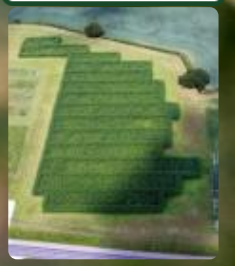
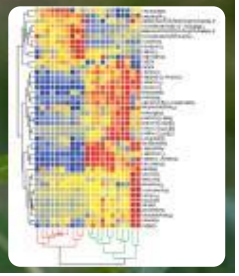
Blue skies > Strategic > P/o concept > Demo > Market

- Untapped, heritable, chemical diversity in willow derived from phenolic glycoside pathway
- mQTL and combined ‘omics have enabled:
  - *Discovery of new reaction mechanisms & bioactive products*
  - *First salicinoid biosynthetic genes identified & validated*
- Current challenges: Elucidation of full pathway and regulators
- Breeding targets: *phenolics for the bioeconomy (pharma-active molecules, bioresins, BTX replacements)*







Delivering Tailoring Plant Metabolism

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