

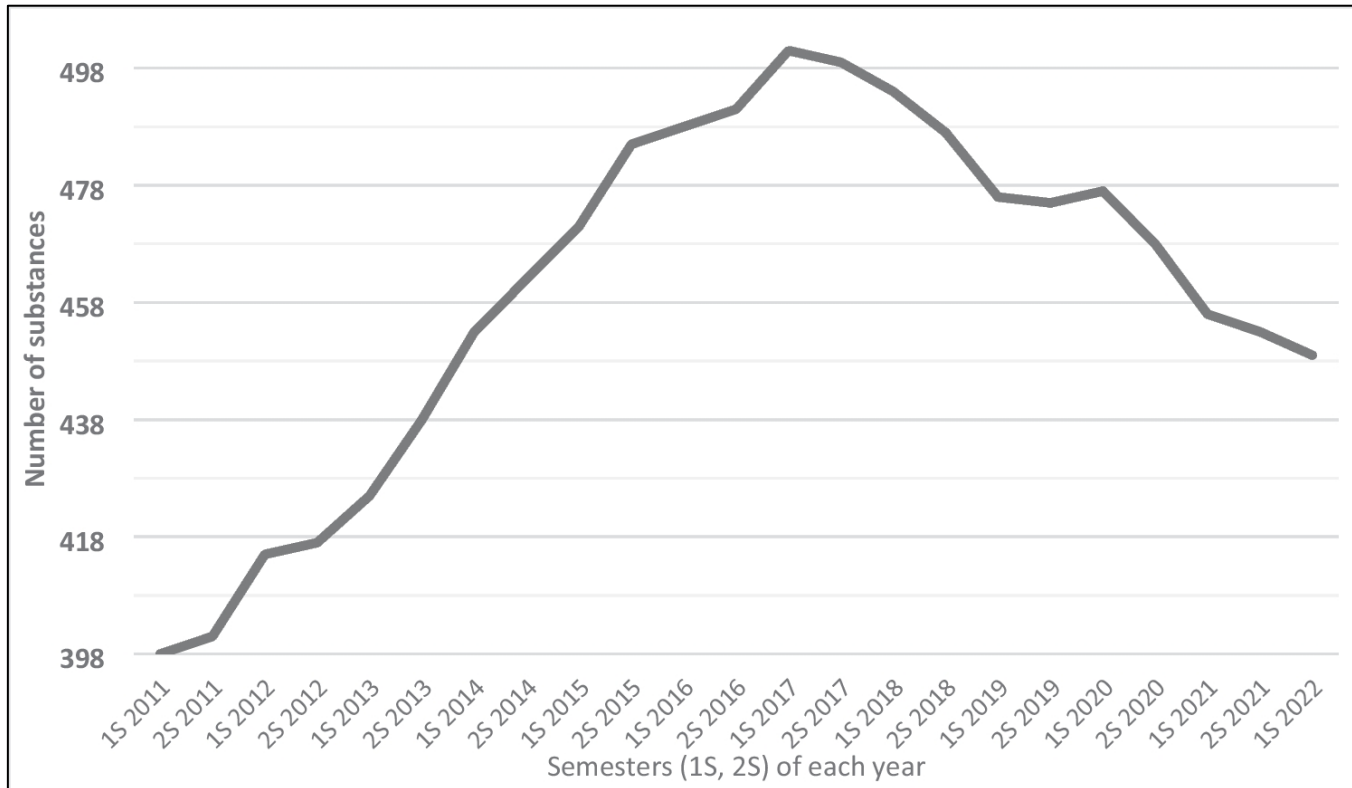


Improving resilience in oilseed rape – From the lab to the field

Rachel Wells
BCPC 08/10/26



Agriculture has a heavy reliance on chemical control



Marchand, 2023. /10.1007/s11356-022-24057-7

- Loss of chemical actives
- Sustainable crop production
- The "Farm to Fork" strategy introduced by the European Union aimed to reduce the use of pesticides by 50% by 2030 – withdrawn
- Impact of withdrawal is rarely modelled

Often withdrawal occurs without predicting the consequences

- Modelling what will happen if growers stick to government plans for chemical withdrawal without any replacements
- Limited work in this area

Table 6: Summary of production sectors with annual gross value added and potential losses if actives at high and moderate risk of withdrawal become unavailable

Crop	Output Value (£m)	Potential output loss (%)	Potential output loss (£m)	Potential impact on Gross Margin (%)
Barley	£362.2m	13.8% - 15.5%	£50m to £54m	-22.6% to -24.6%
Potatoes	£253.7m	20%	£51m	-50.3%
Vegetables	£128.5m	25%	£32.1m	-50%
Wheat and Oats	£211.3m	7%	£14.8m	-10.7%
Soft fruit	£153.9m	23%	£35.4m	-221%
Forestry	£529m	10%	£53m	-27.4%

J. Dimmock, M. Bowsher-Gibbs, H. Blackmore, S. Thompson and K. Dainton. (2023).

A targeted analysis of the impact of insecticide withdrawals in Scotland, in the context of alternative control options: Project Final Report. PHC2021/06.

Scotland's Centre of Expertise for Plant Health (PHC). DOI:

10.5281/zenodo.8129668

Available online at:

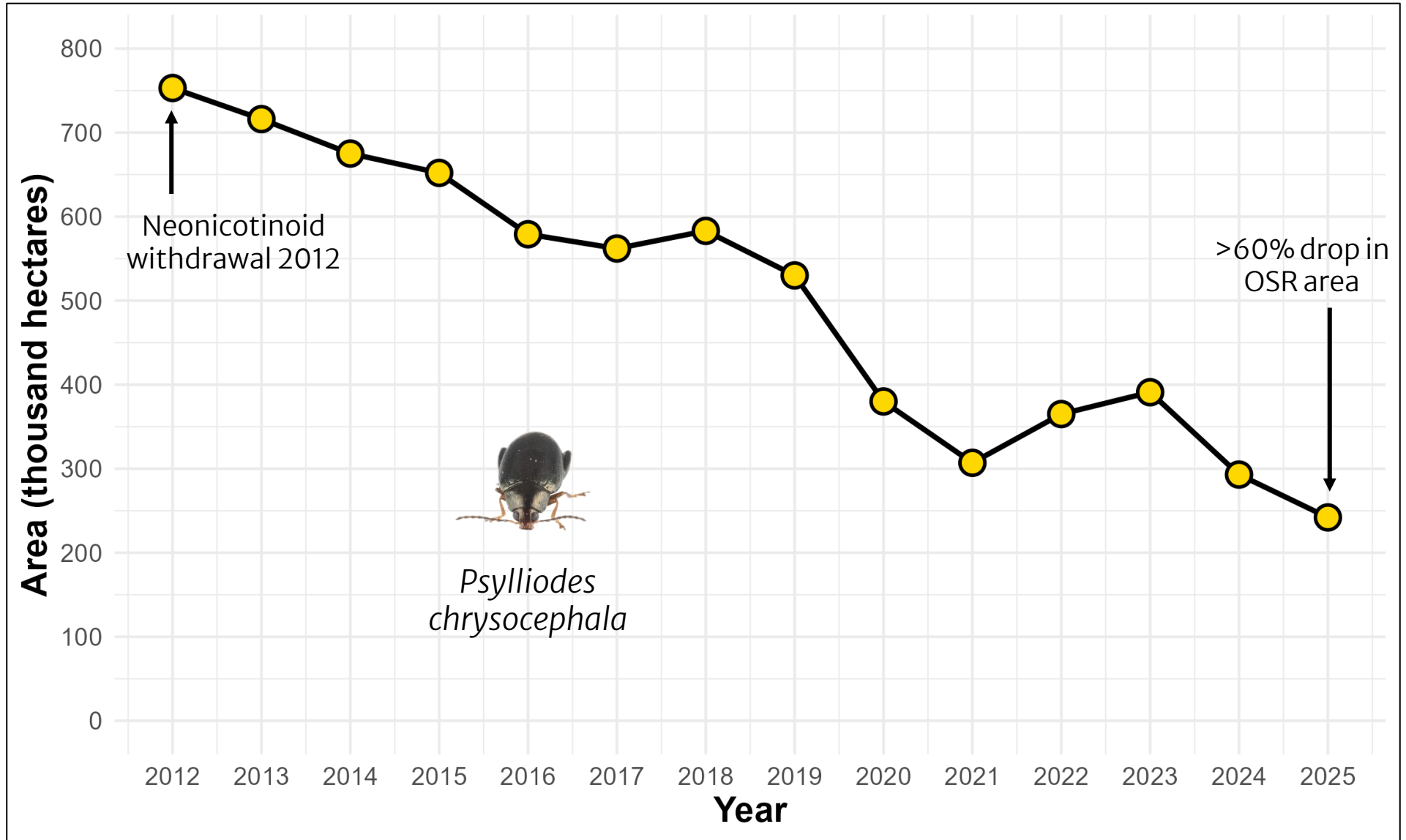
planthealthcentre.scot/publications

Oilseed rape – an example of chemical withdrawal

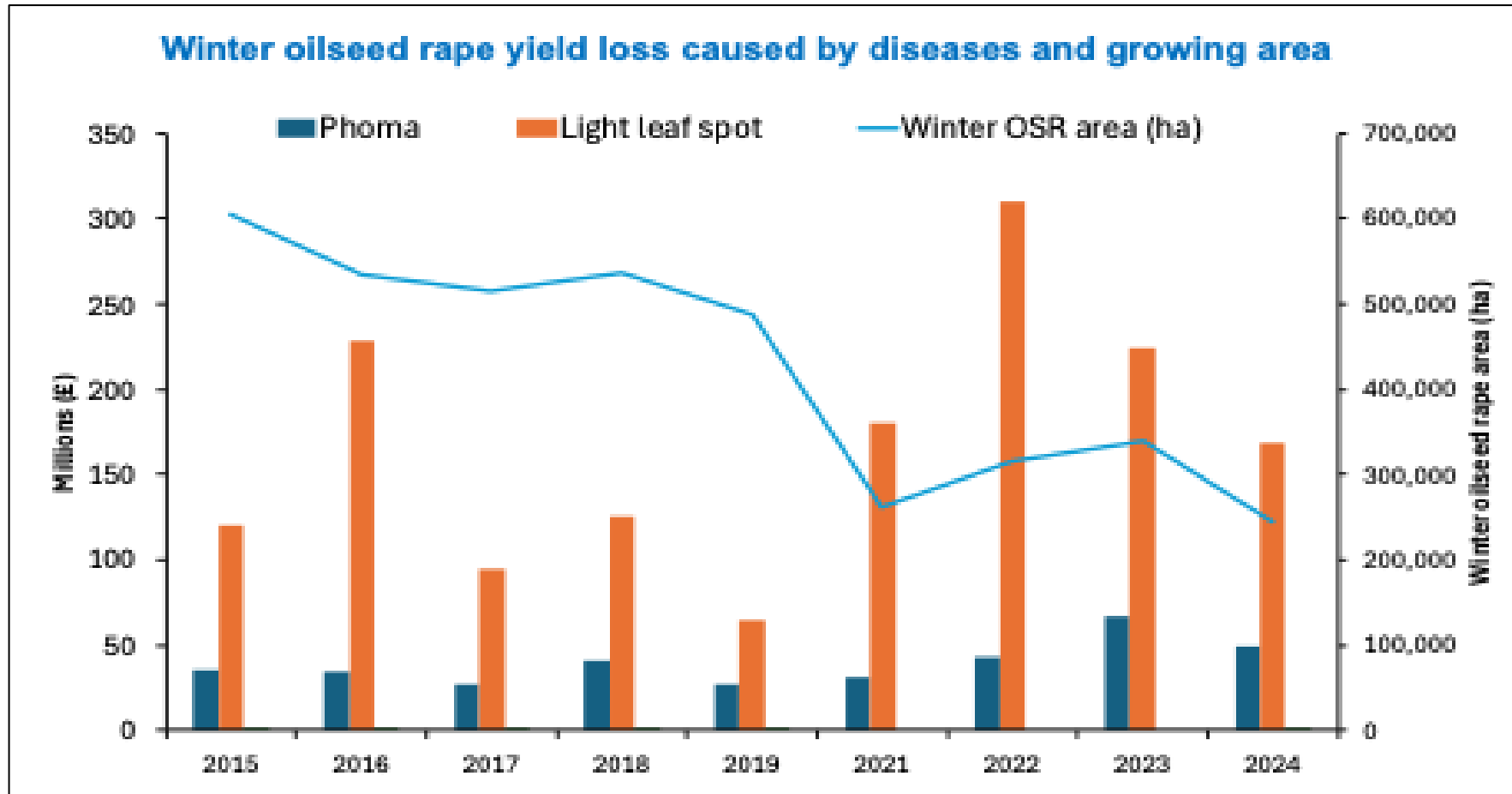
- Winter sown oilseed rape (99% of the total oilseed rape area)
- Source of edible and industrial oils
- Most valuable UK break crop
- Essential part of UK crop rotation
- Future in crisis



The area of OSR in the UK has seen a massive decline since 2012



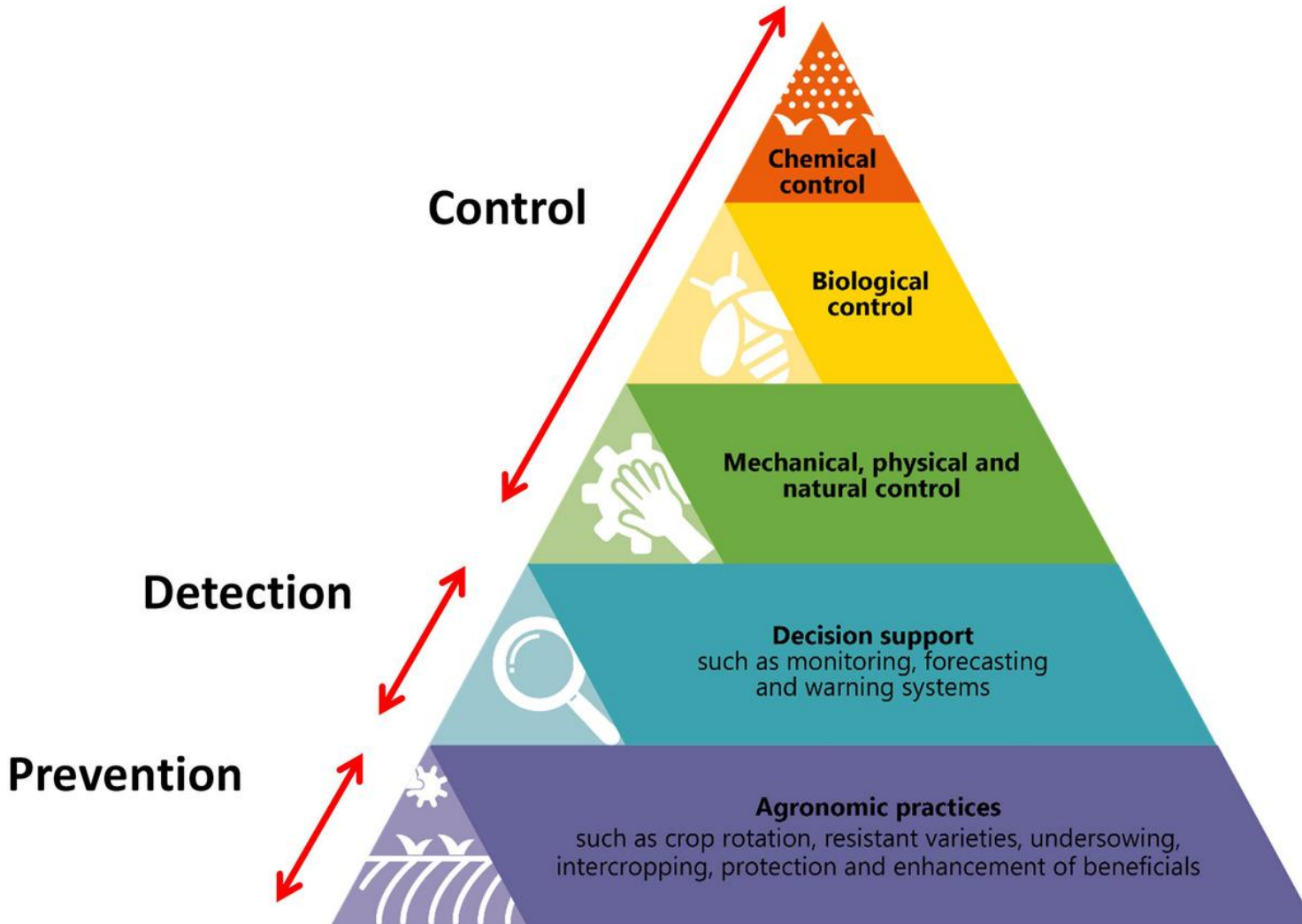
Further disease challenges exist for the remaining crop



Sustainable OSR?

How do we
reduce reliance
on chemical
controls?

IPM offers a holistic system to combat pests and disease



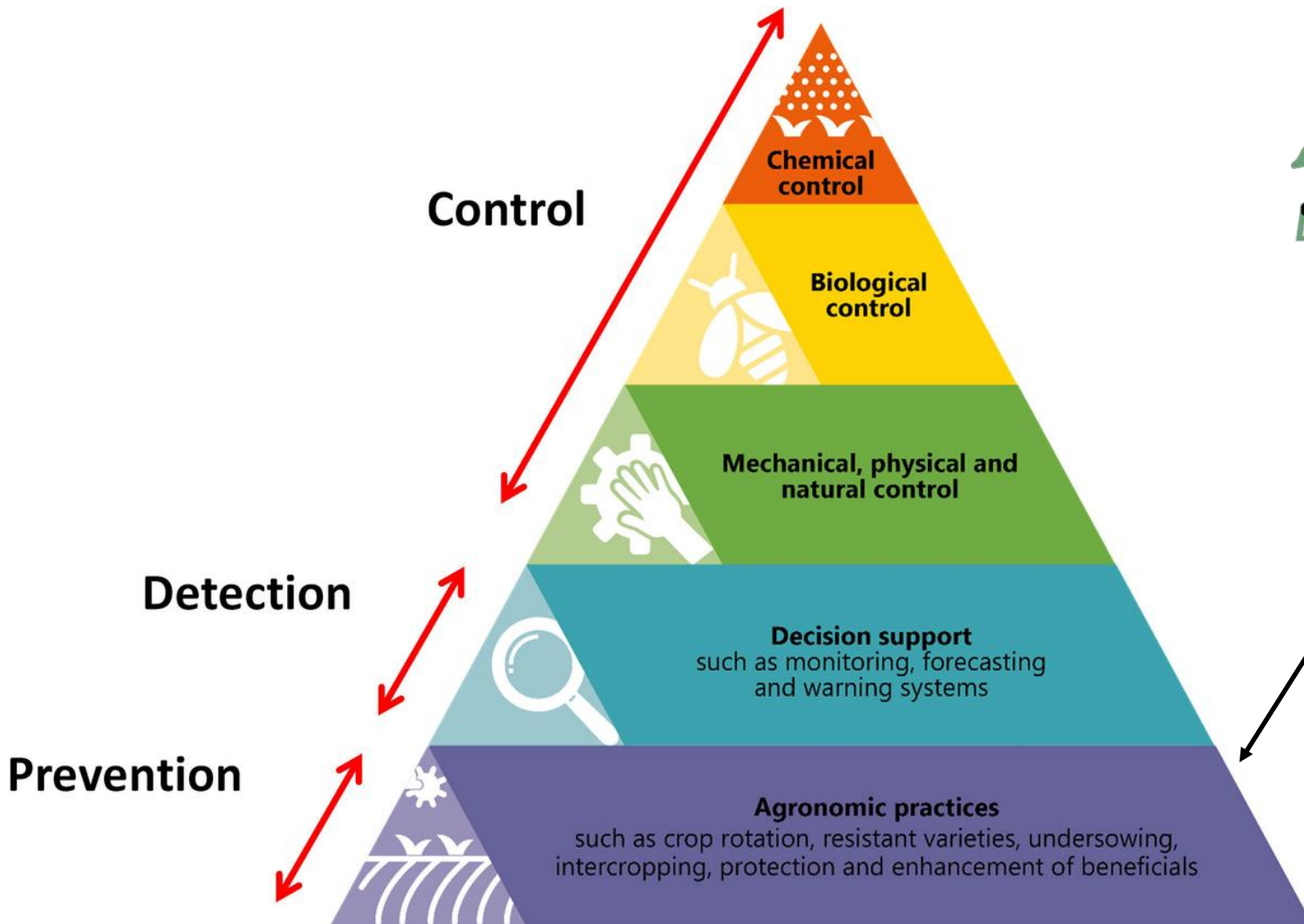
1. Understand the disease and crop
Biology, life-cycle, diversity, interaction, susceptibility of crop to disease

2. Current control measures
What and how it works, withdrawals, regulatory landscape

3. Natural controls
What and how it works, efficacy, regulatory landscape – genetic resistance, PBO, GM

4. Directed research and development
Apply knowledge from 1 and 3 to combat disease

Associative transcriptomic approaches for genetic resistance



Mechanistic Analysis of Quantitative Disease Resistance in Brassicas by Associative Transcriptomics

Alternaria, sclerotinia, stem canker, verticillium, LLS and PAMP responses – specialist Brassica pathologists

What is quantitative disease resistance (QDR)?

Major gene resistance

- One or a few genes of large effect
- Race-specific, meaning they recognize specific pathogen strains
- All-or-nothing (resistant or susceptible) outcome
- Breaks down easily when pathogens mutate or evolve new races

QDR– (polygenic or minor gene)

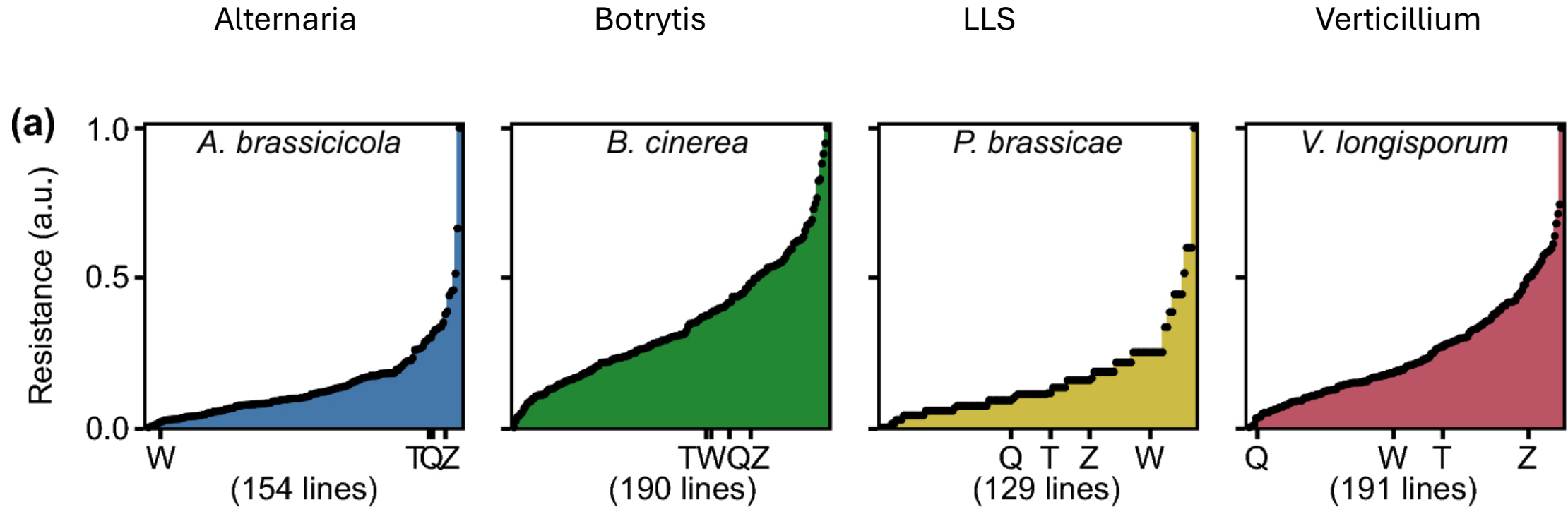
- Many small-effect loci or quantitative trait loci (QTL) working together
- Non-race-specific and works against a broader range of pathogen isolates
- Slows down pathogen growth and spread, reducing disease severity
- More durable and stable over time because it forces the pathogen to overcome multiple small defence barriers

Understanding susceptibility in a common diverse panel of lines

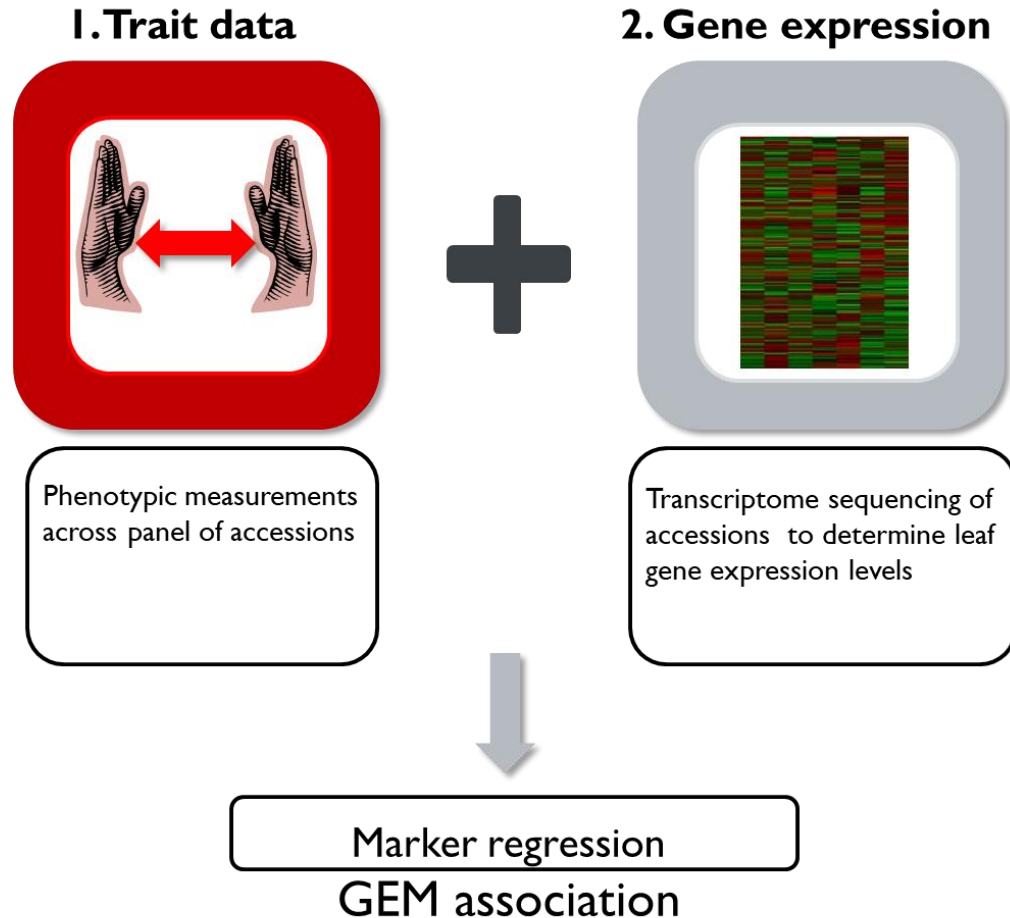


- Development of robust controlled assays
- All lines were transcriptome sequenced
- SNP markers – genetic variants
- Gene expression levels
- Statistical correlation between resistance to the disease and genetic variation
- Novel resistance/QDR?

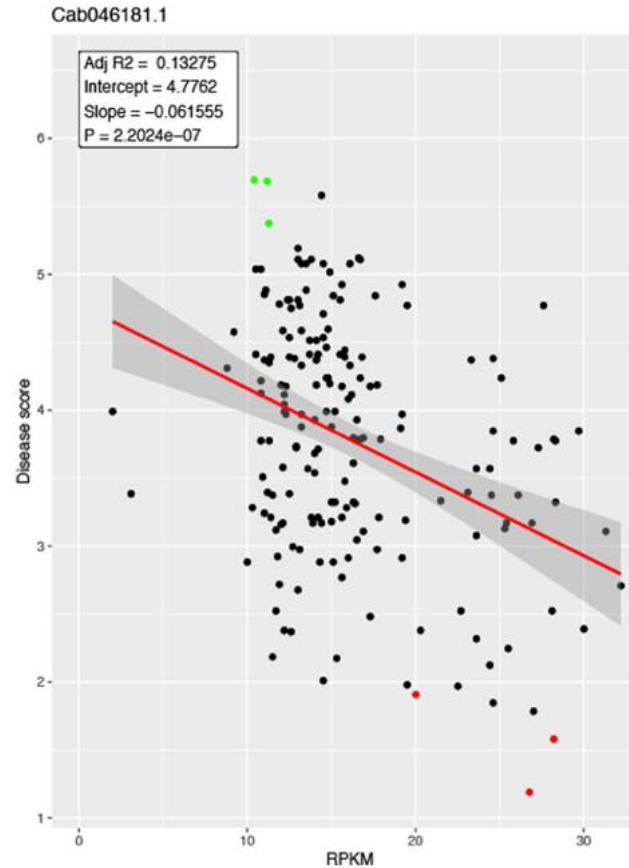
QDR to all pathogens tested is present within the *B. napus* panel



Gene expression can be associated with resistance

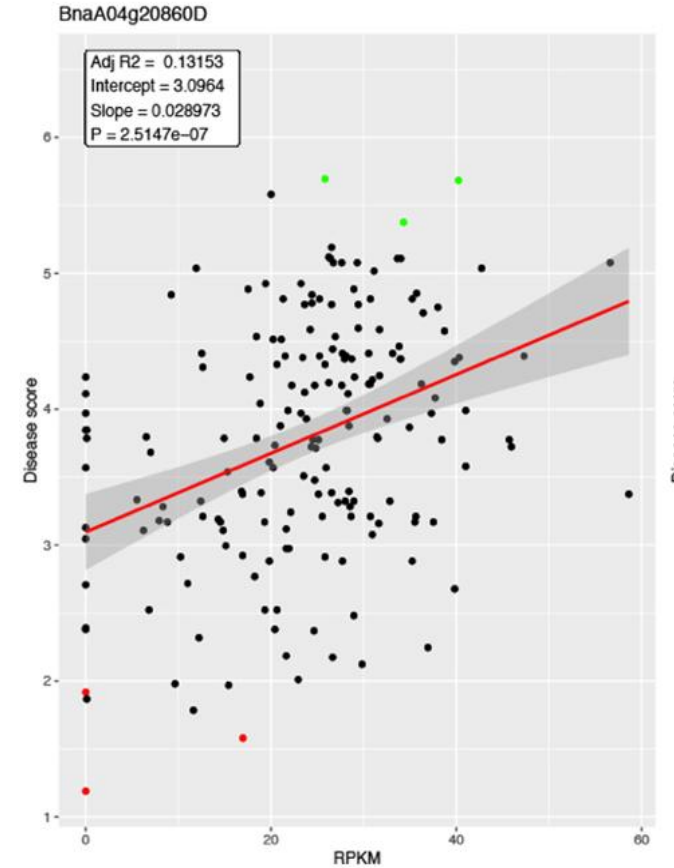


Resistance factor



High expression
leads to resistance

Susceptibility factor



High expression leads
to susceptibility

Genes expression associated with resistance relate to pathogen lifestyle

Necrotrophic pathogens (Altenaria and Botrytis)

- Actively kill host tissue during colonisation
- Share associated gene markers

Hemibiotrophic pathogens (LLS and Verticilium)

- Initially keeps the host alive when colonising before switching to necrotrophy
- Share associated gene markers
- No common gene markers between necrotrophic and hemibiotrophic pathogens
- Some genes associated with resistance to one pathogen associate with susceptibility to another
- Genes associated with susceptibility – novel targets for breeding

Res. GEMs			
	B.c	P.b	V.i
A.b	73	0	0
B.c		0	0
P.b			89

Sus. GEMs			
	B.c	P.b	V.i
A.b	56	0	0
B.c		0	0
P.b			42

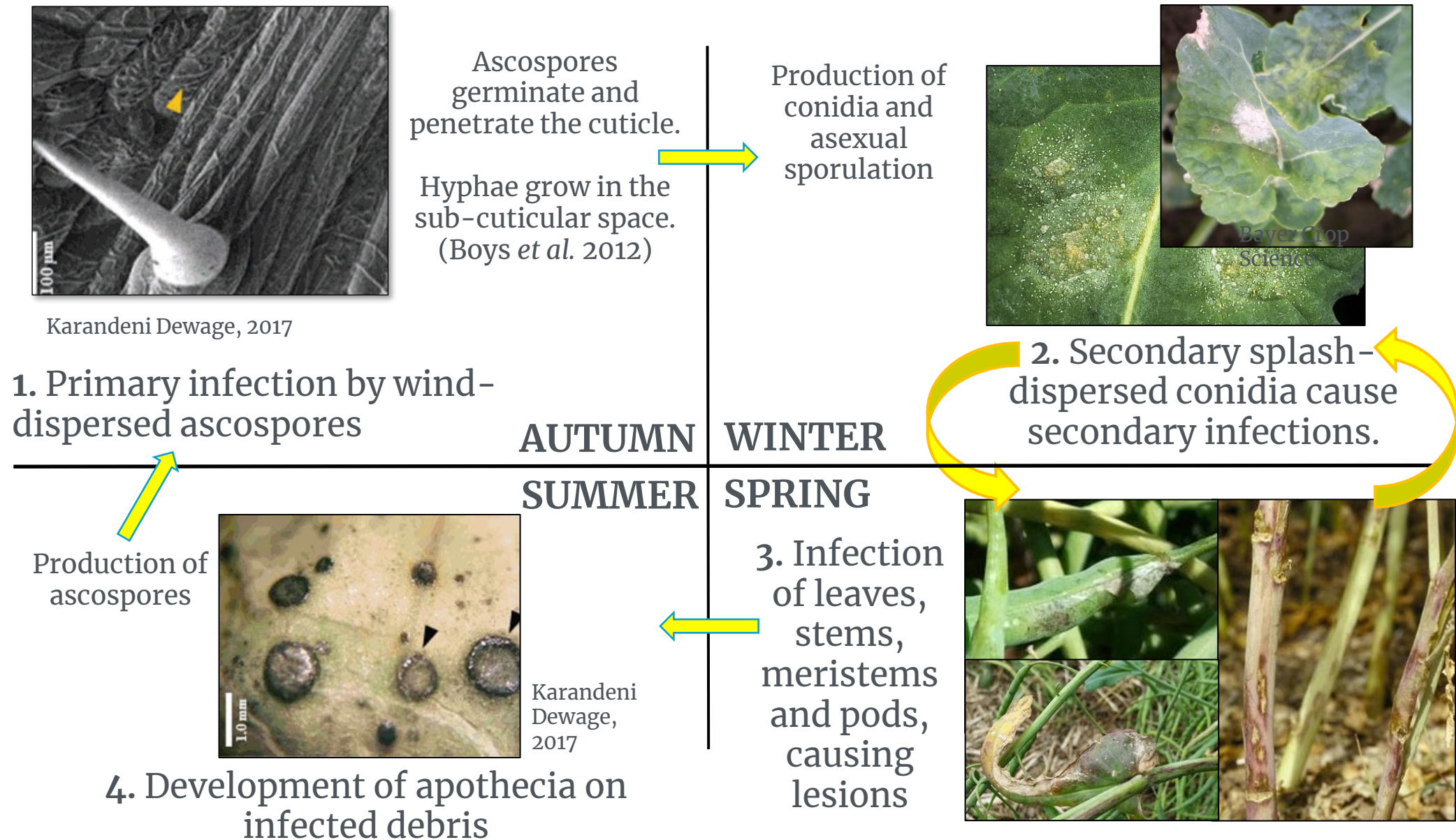
Res. GEMs			
	A.b	B.c	P.b
V.i	NA	0	54
A.b		769	78
B.c			0
P.b			NA
V.i			

Sus. GEMs

Cat Jacott



Pyrenopeziza brassicae causes LLS, a polycyclic disease



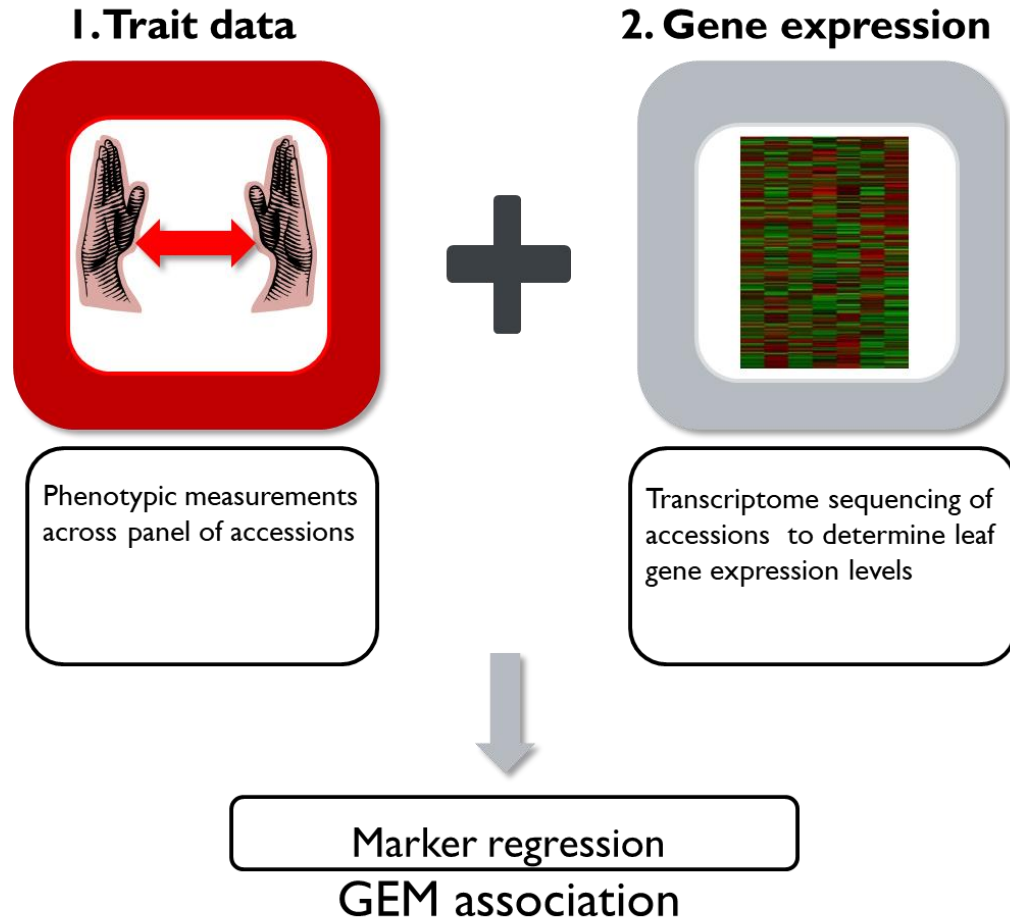
Control of light leaf spot

- Use of resistant varieties
- Major gene resistance – potential breakdown of resistance
- Cultivation techniques – burying stubble to reduce spore count
- Fungicides – reliance on chemical control
- Novel resistance?

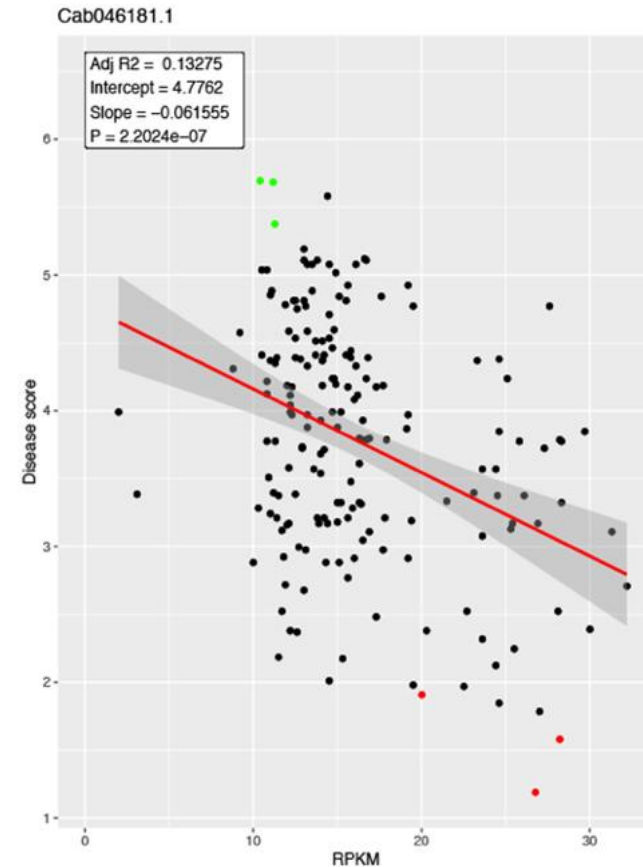
Henrik
Stotz



Gene expression can be associated with resistance

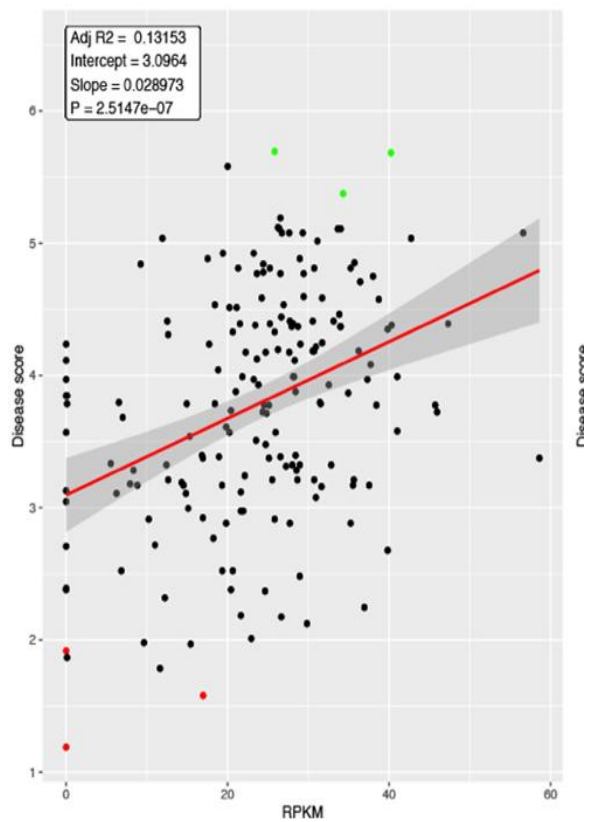


Resistance factor - 7

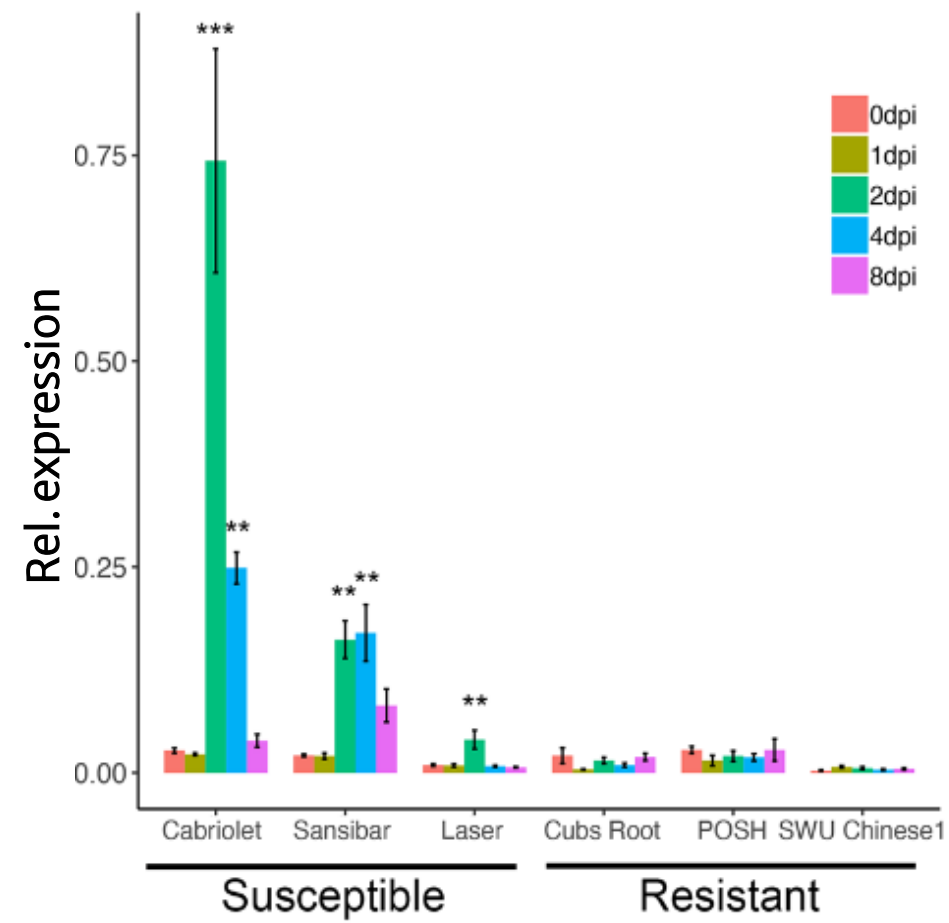


High expression
leads to resistance

Gene expression associated with susceptibility to LLS (FDR of 0.001)



High expression associated with susceptibility

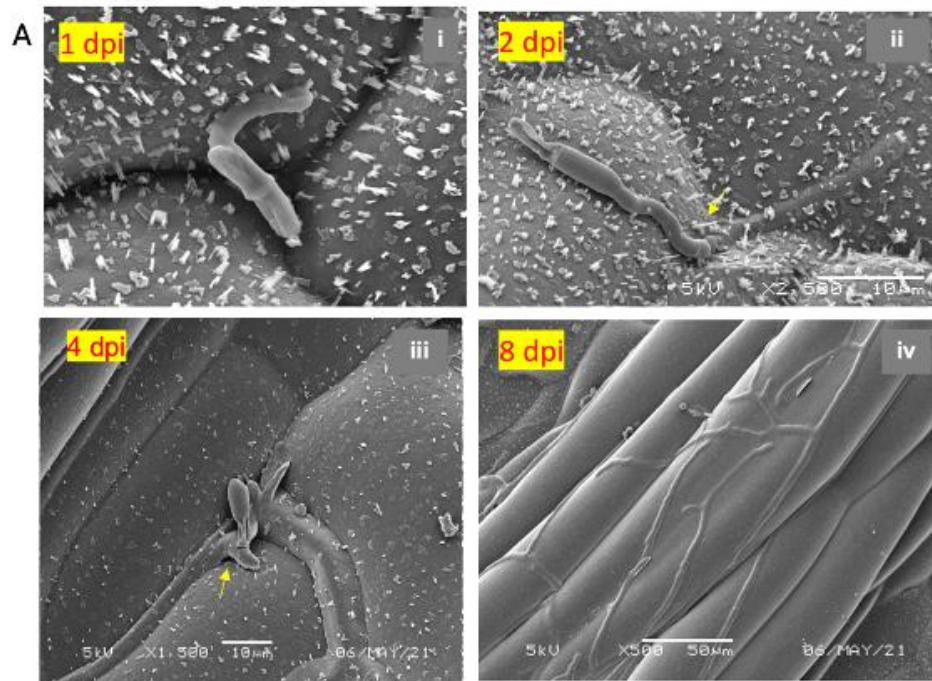


Expression activated in susceptible lines at 2dpi

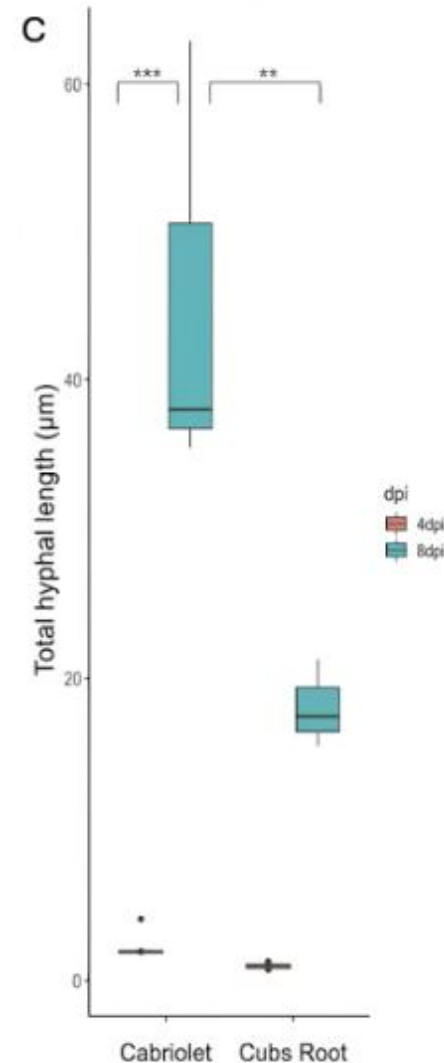


Henrik Stotz
Ajisa Muthayil Ali
University of Hertfordshire **UH**

Gene expression associated with susceptibility to LLS (FDR of 0.001)



Pathogen penetration
and hyphal spread
occur from 2dpi



- Resistant line shows a slow of pathogen growth and spread
- By reducing gene expression, we should increase resistance



Henrik Stotz
Ajisa Muthayil Ali
University of Hertfordshire **UH**

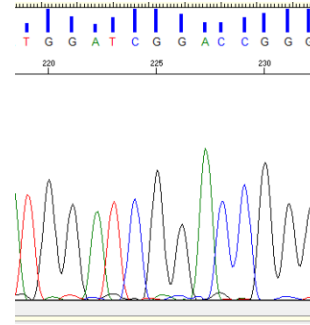
Mutagenesis allows us to test gene function

TILLING (Targeting Induced Local Lesions IN Genomes) – variety Cabriolet (susceptible)



Treatment to induce mutations e.g. chemical

Random changes across the genome



Select lines with mutations

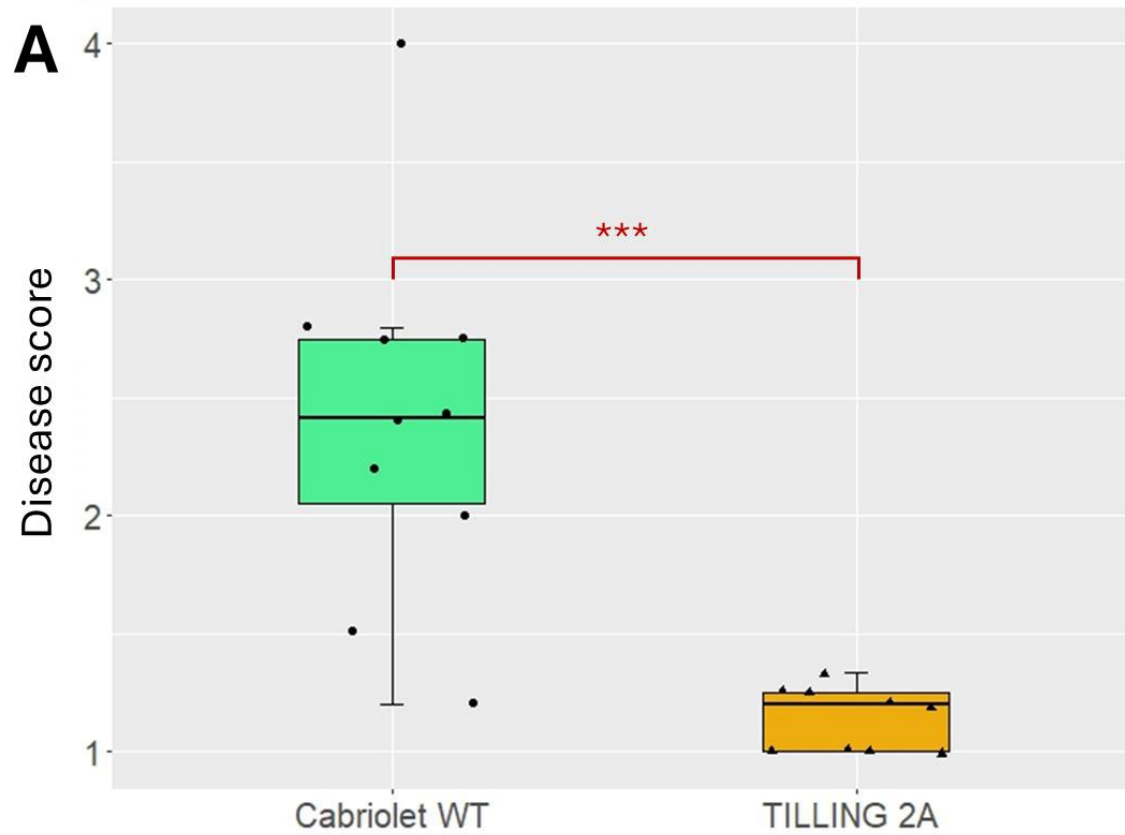


Phenotyping for disease symptoms

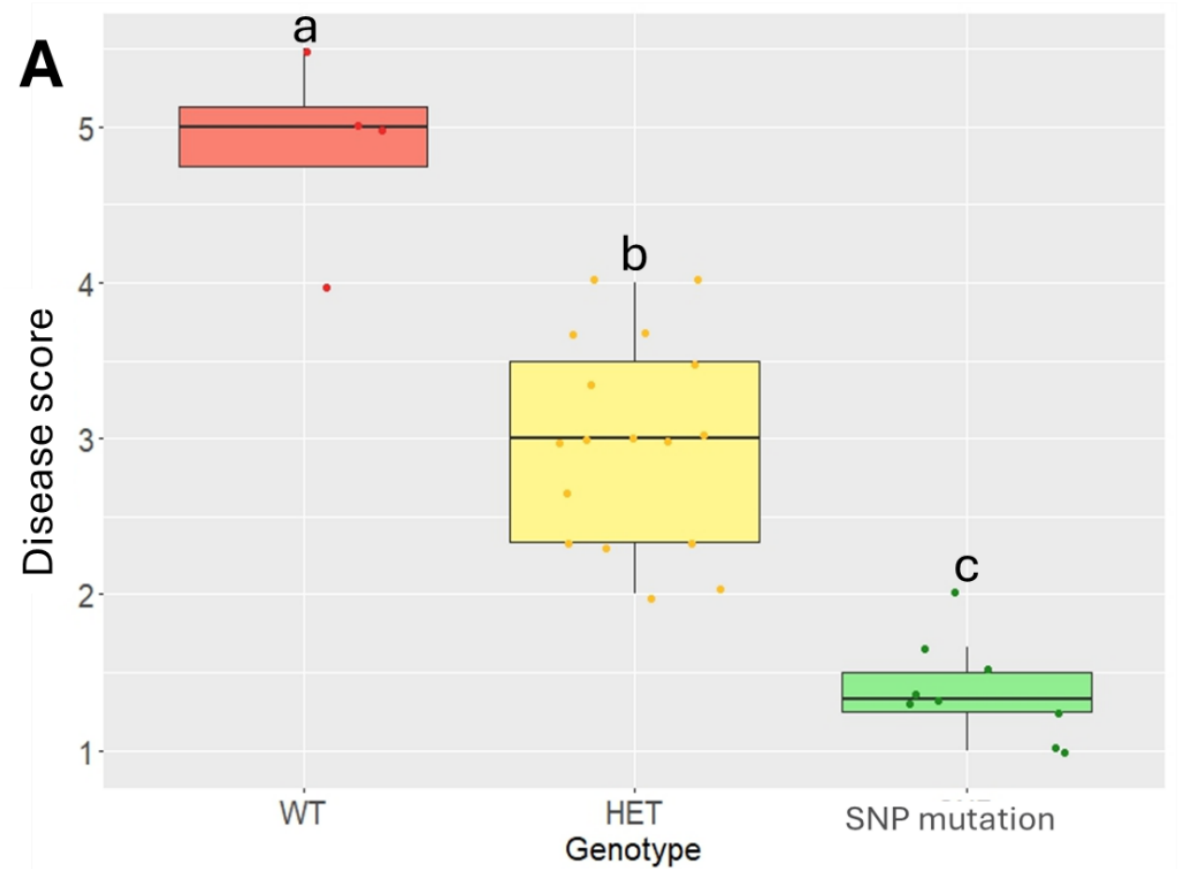


Saleha Bakht
JIC Molecular genetics platform

Mutation of the putative susceptibility factor improves resistance



Mutation in the main protein domain significantly reduces disease



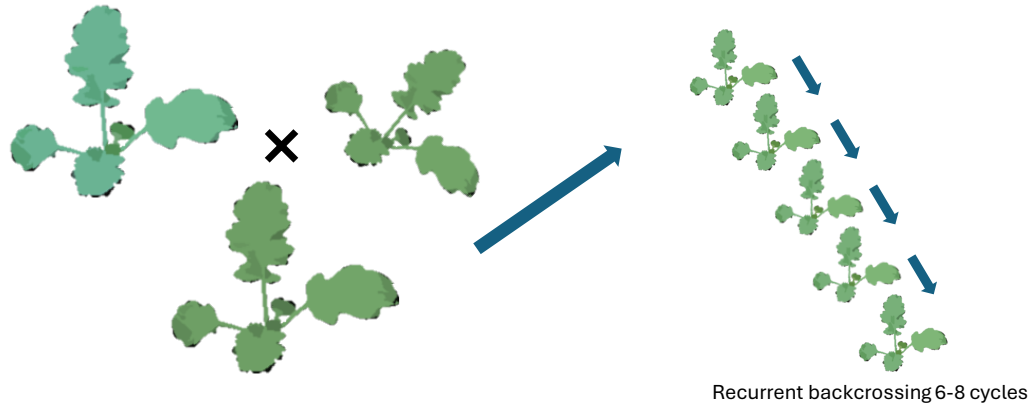
Production of a truncated protein confirms the effect



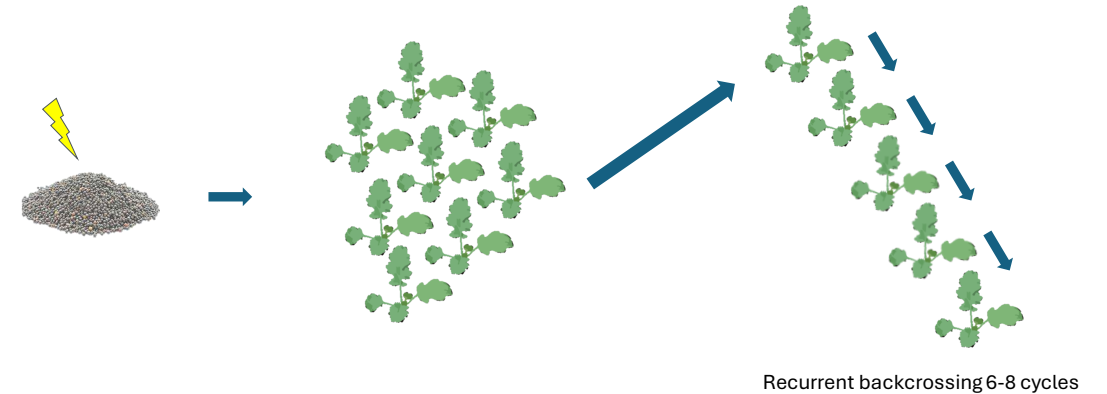
Henrik Stotz
Laura Gimenez Molina
University of Hertfordshire **UH**

Genome editing can rapidly accelerate variety development in a desirable background

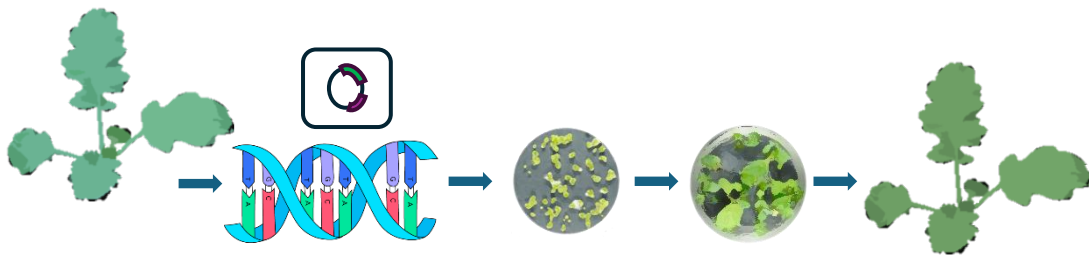
Conventional breeding (8–10 years)



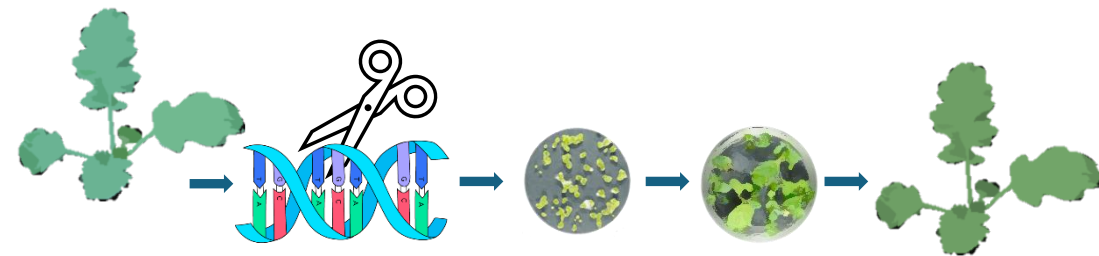
Mutation breeding (8–10 years)



Transgenic breeding (4–6 years – GMO)

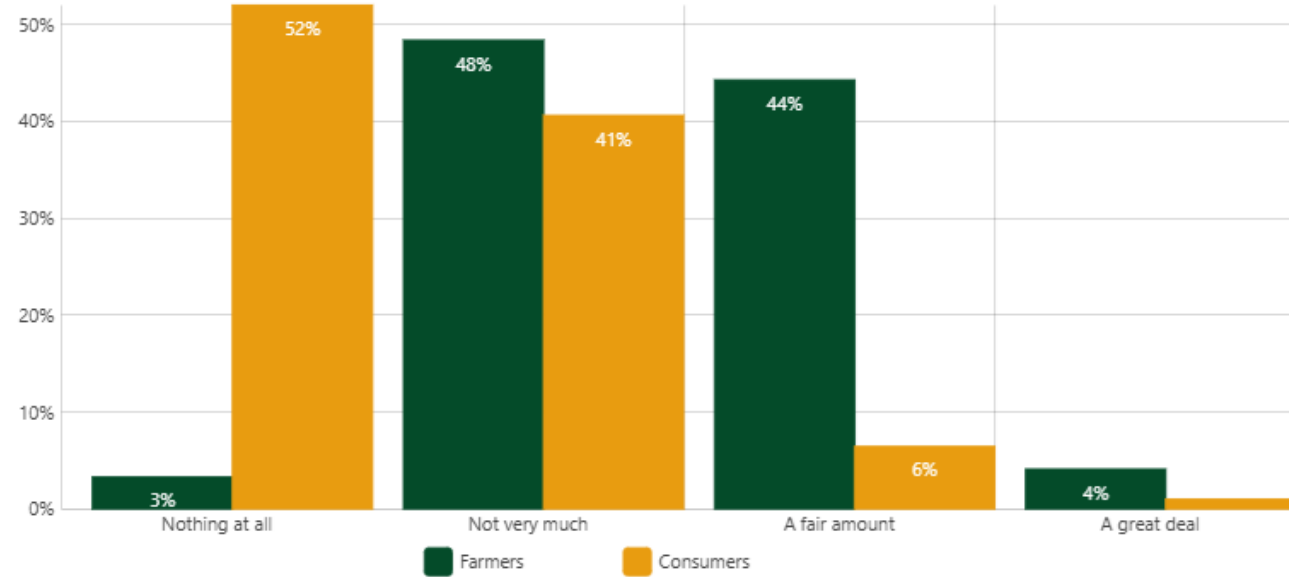


Genome editing (4–6 years – PBO)



Awareness of precision breeding

Before today, how much, if anything, had you heard about precision breeding or gene editing in UK food crops?



Genome/Gene Editing: CRISPR/Cas

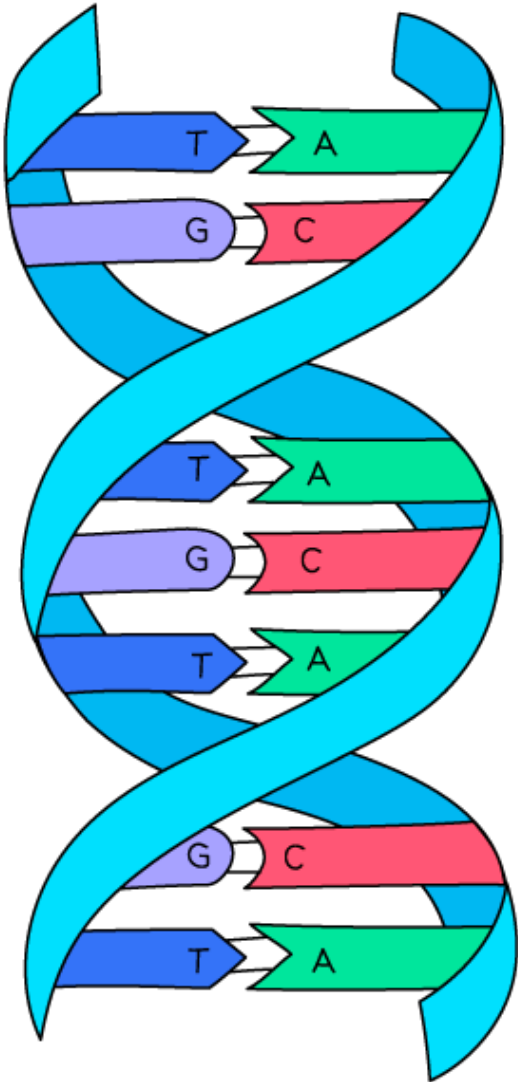
Tool that allow us to cut the DNA at a precise location



Delete/ edit genetic sequence: to create a gene 'knock out'
Regulated as Precision Bred Organisms (PBOs)

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Genomic sequence

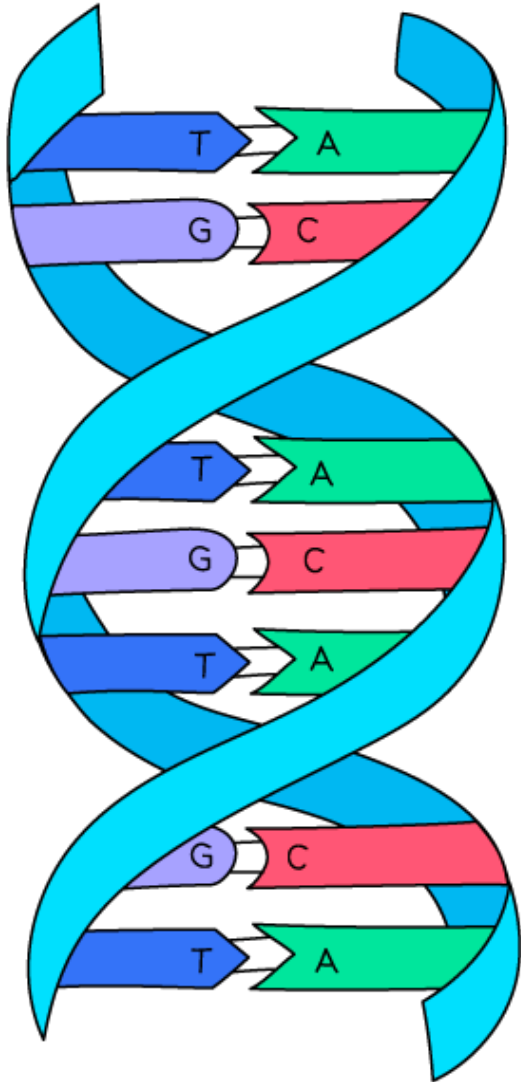


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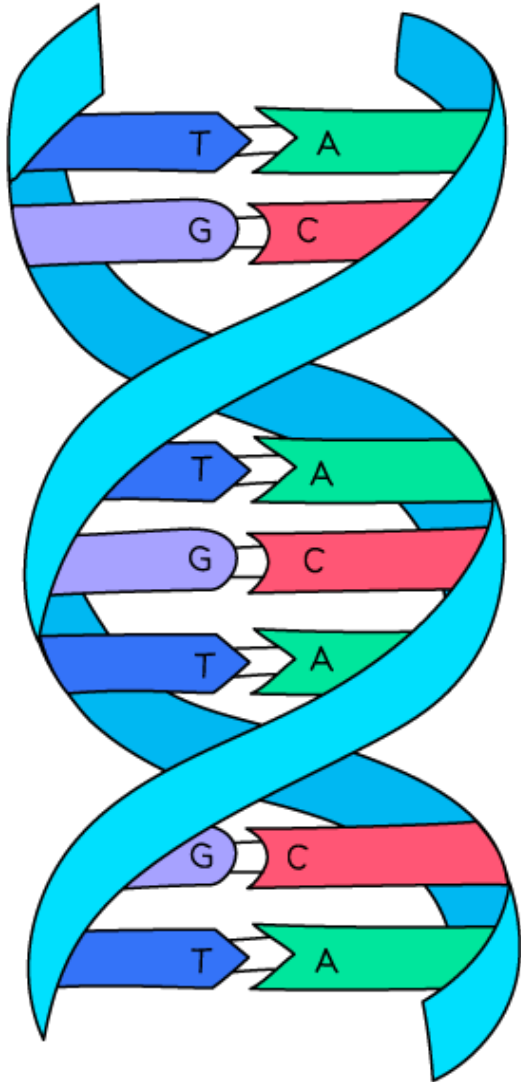
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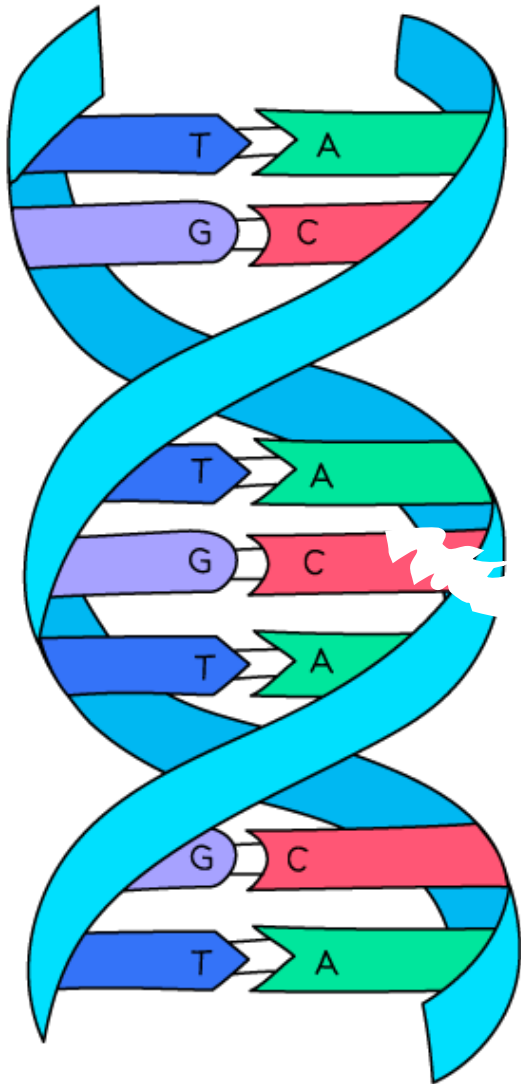
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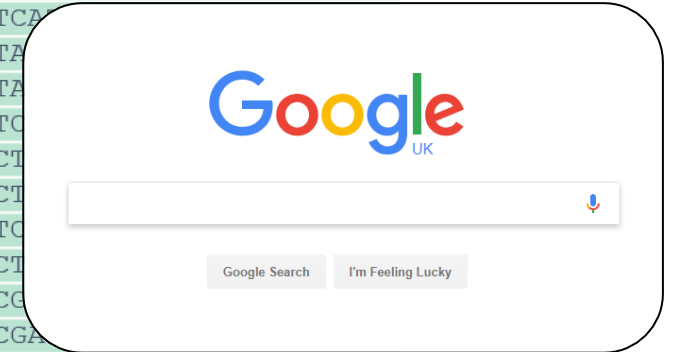
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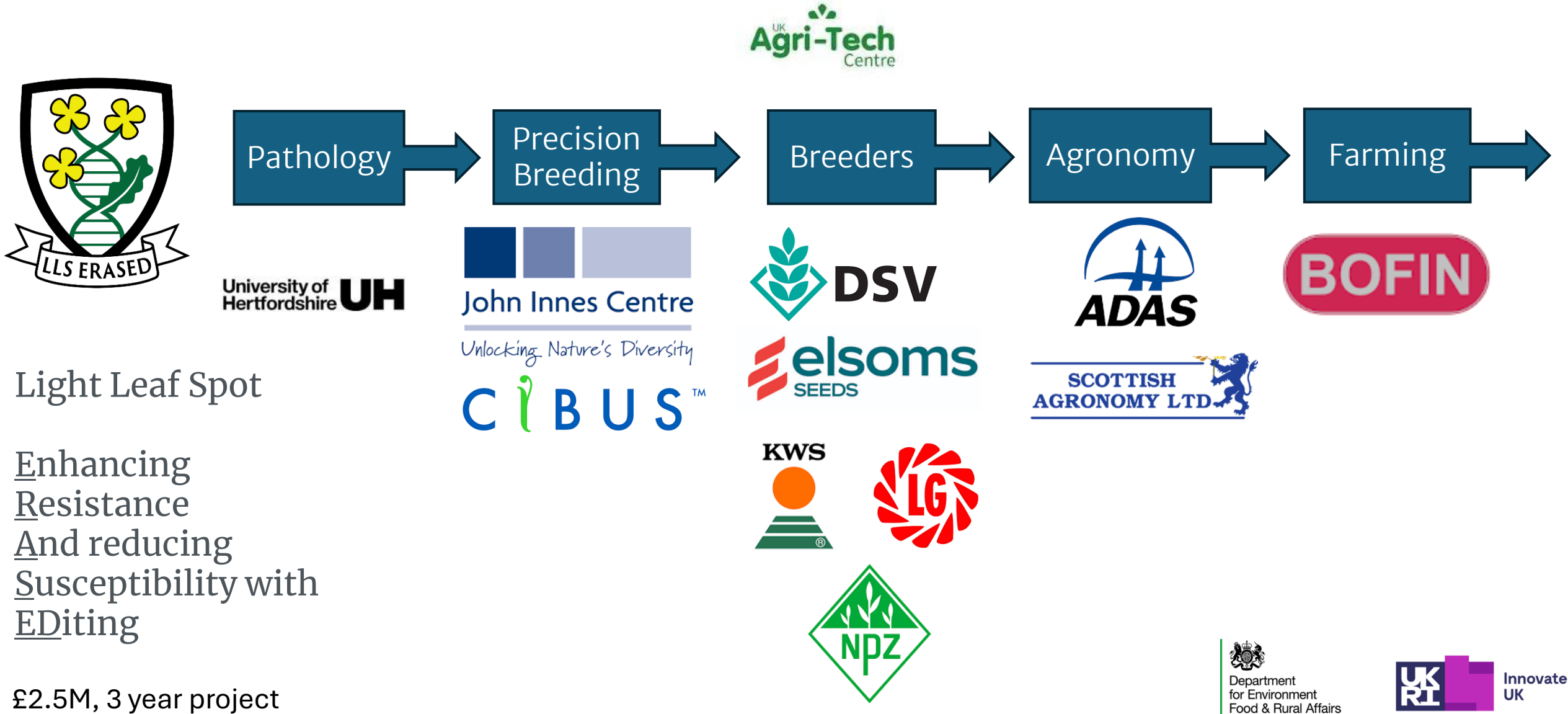


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A molecular guide (gRNA) and a nuclease (Cas protein)

Innovate Farming Futures: Precision Breeding R and D Fund



Develop IPM approach with **three innovations**:

1. Best practice and advancement of precision-bred OSR

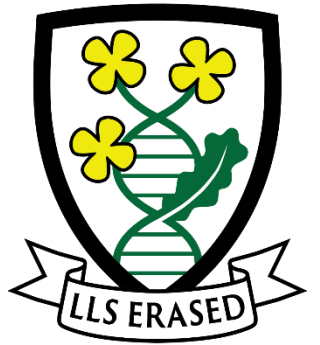
- TILLING mutants and PBO approval to **field trials** with UK growers
- Develop elite winter OSR line using **protoplast GE** technology

2. Risk forecasting to provide real-time decision making

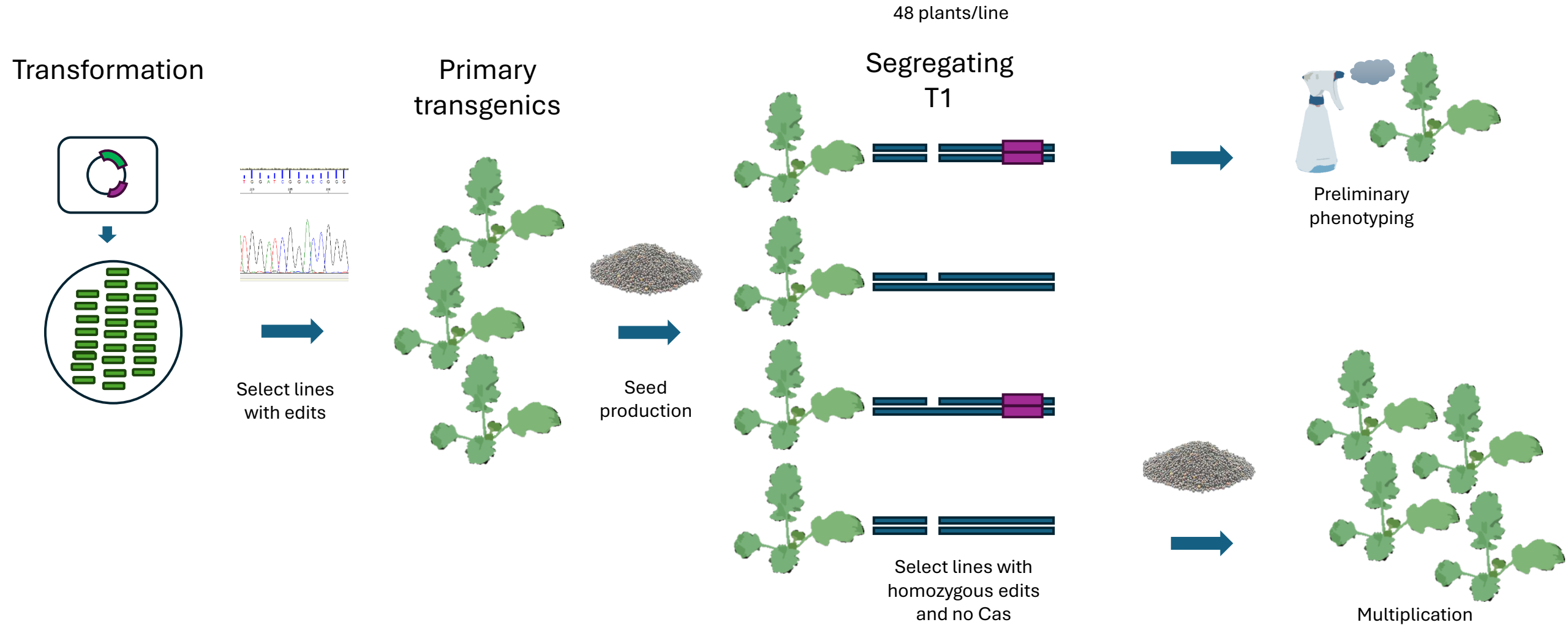
- Monitor **new virulent races** in farmer-led trials
- Molecular markers for **rapid detection of pathogen** race structure
- Develop a new **decision support tool** for fungicide application guidance

3. Grower-led platform to share skills, resources and foster understanding

- Farmer-led field trials providing **pipeline of OSR traits** to industry
- Knowledge exchange and **stakeholder engagement campaign**, working with AHDB



The precision bred organism pipeline



Best practice for the advancement of PBOs

- Establishing precision bred status of plants
- Adopting appropriate measures to minimise the risk of material from the precision bred plant being released into the environment or placed on the market
- PCR/whole genome sequencing (WGS) to confirm the absence of foreign DNA in any material that will be released as a PBO
- Aligns with Defra recommendations and published methods
- Illumina: short read but affordable
- Bioinformatics for detection and threshold: Assess the presence of vector sequences in the sampled plant DNA

First PBOs in breeder's elite varieties in 18 months

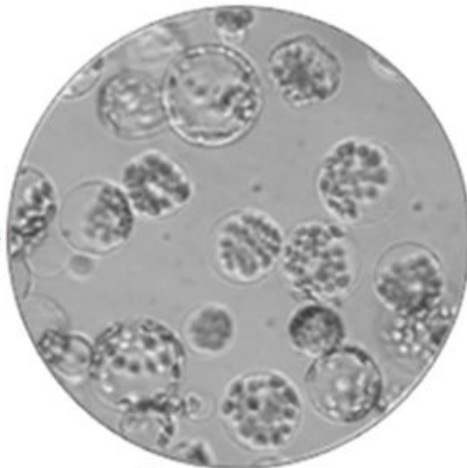
CIBUS™

Rapid Trait Development System™

Transgene free specific edit
Del/Insertion
Base pair change



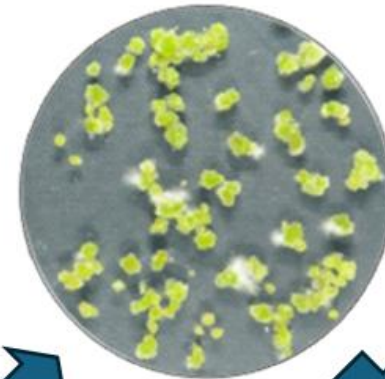
Breeder variety



Protoplast



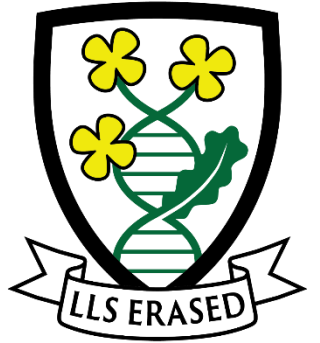
Microcalli



Callus



Plantlet



Moving from the lab to field trials

Confirm
absence of
transgenes



Advisory Committee
on Releases to
the Environment

Research and analysis

ACRE guidance on producing precision bred plants

Published 13 November 2025

Applies to England

Notify DEFRA of
trials

Guidance Submitting a release notice for a precision bred plant

Updated 9 April 2026

Applies to England

John Innes Centre: 22nd January 2026

John Innes Centre guidelines for precision-bred plant field trials

James Simmonds¹, Penny Hundleby¹, Matt Heaton^{2,1}, Nikolai M. Adamaki¹, Burkhard Steuernagel¹,
Christopher Darby^{3,1}, Diane G.O. Saunders¹, Cristóbal Uauy^{1*} & Darryl Playford^{1*}

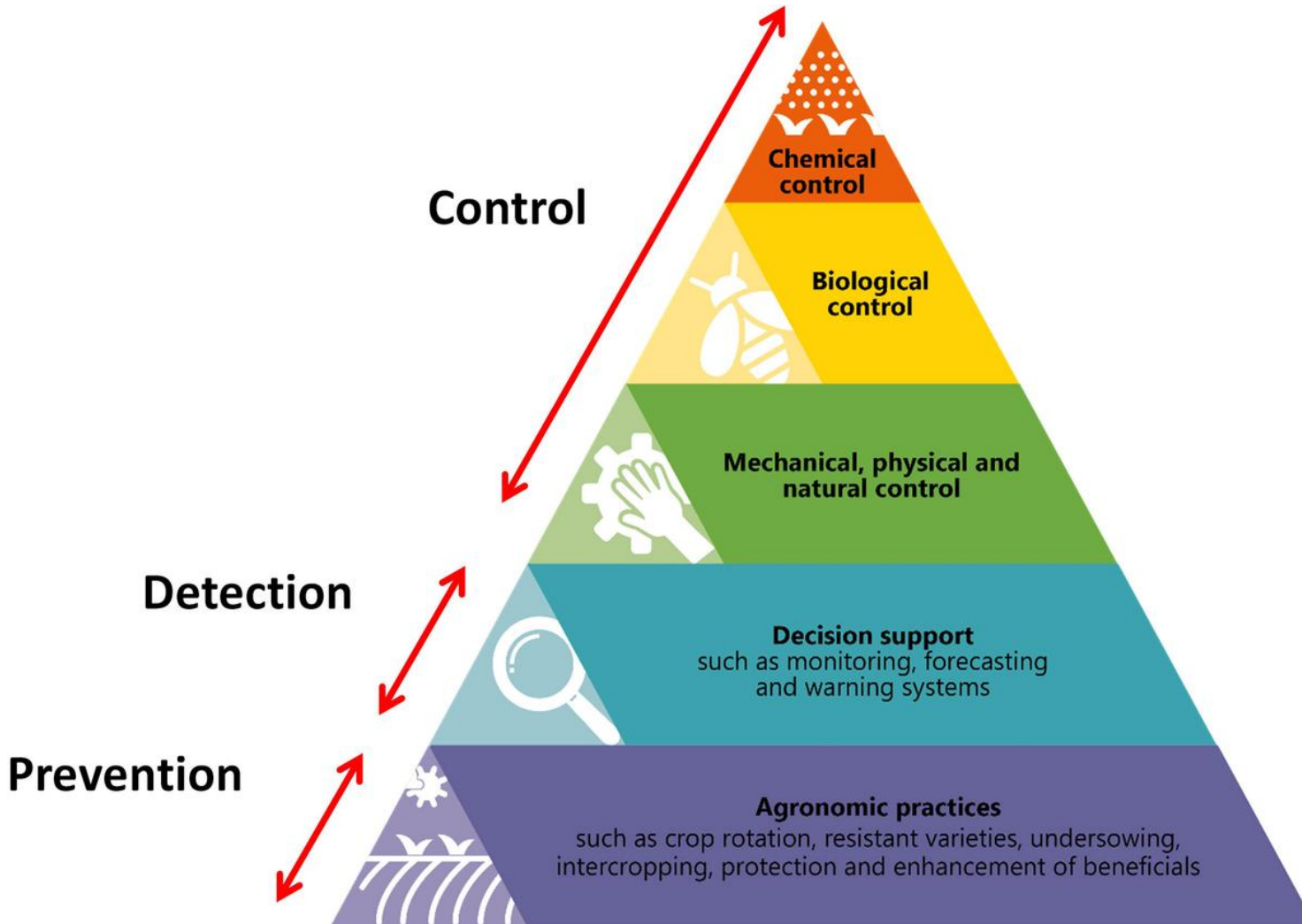
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Field trial best practice

- Pollen barriers
- Isolation distance
- Seed certification requirements
- Management practices for future crops
- Clean machinery
- Prevent spread through wildlife
- Emergency procedures

What have we learnt about LLS?



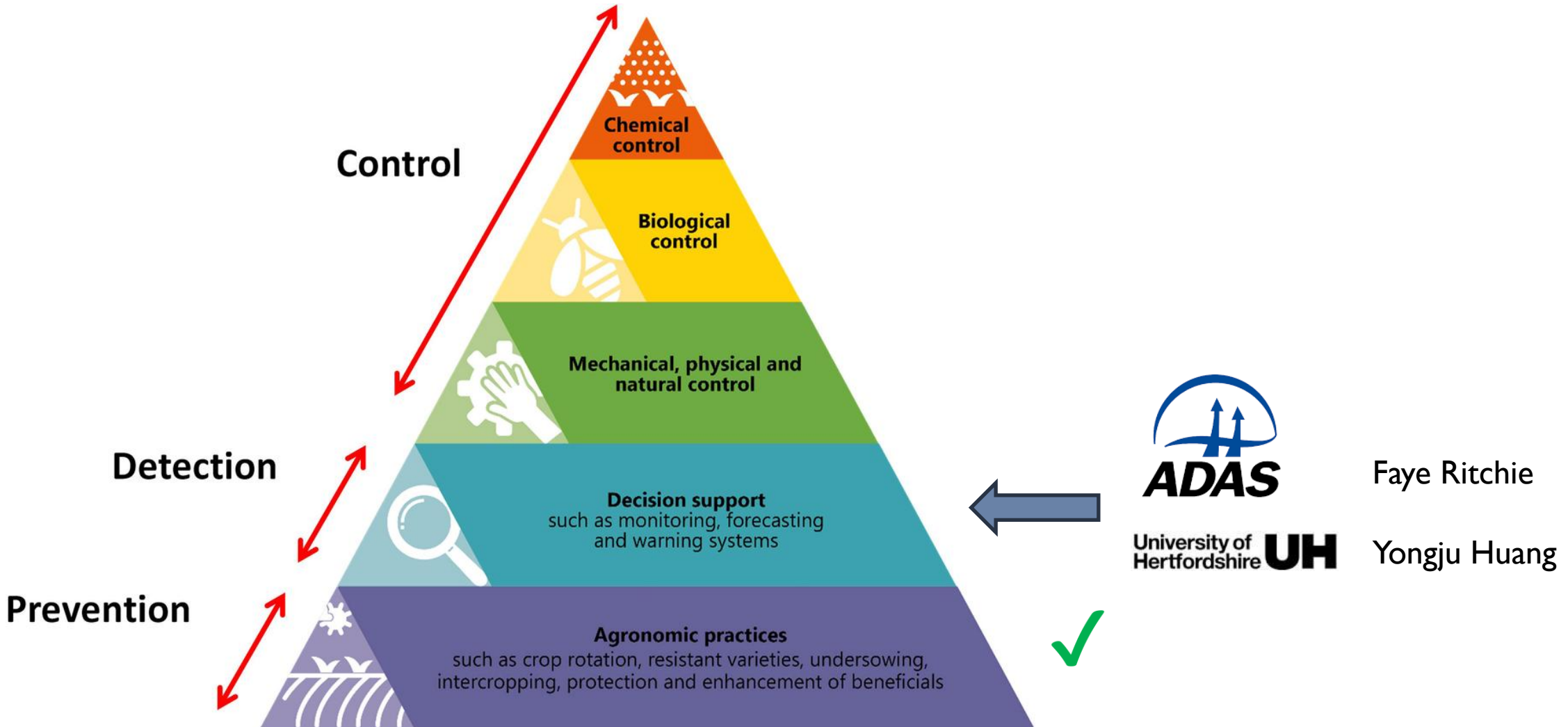
1. Understand the disease and crop
Biology, life-cycle, diversity, interaction,
susceptibility of crop to disease

2. Current control measures
What and how it works, withdrawals,
regulatory landscape

3. Natural controls
What and how it works, efficacy,
regulatory landscape – genetic
resistance, PBO, GM

4. Directed research and development
Apply knowledge from 1 and 3 to combat
disease

IPM offers a holistic system to combat pests and disease



Develop IPM approach with **three innovations**:

1. Best practice and advancement of precision-bred OSR

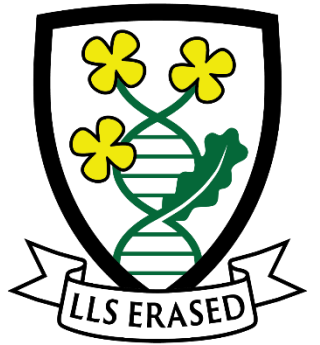
- TILLING mutants and PBO approval to **field trials** with UK growers
- Develop elite winter OSR line using **protoplast GE** technology

2. Risk forecasting to provide real-time decision making

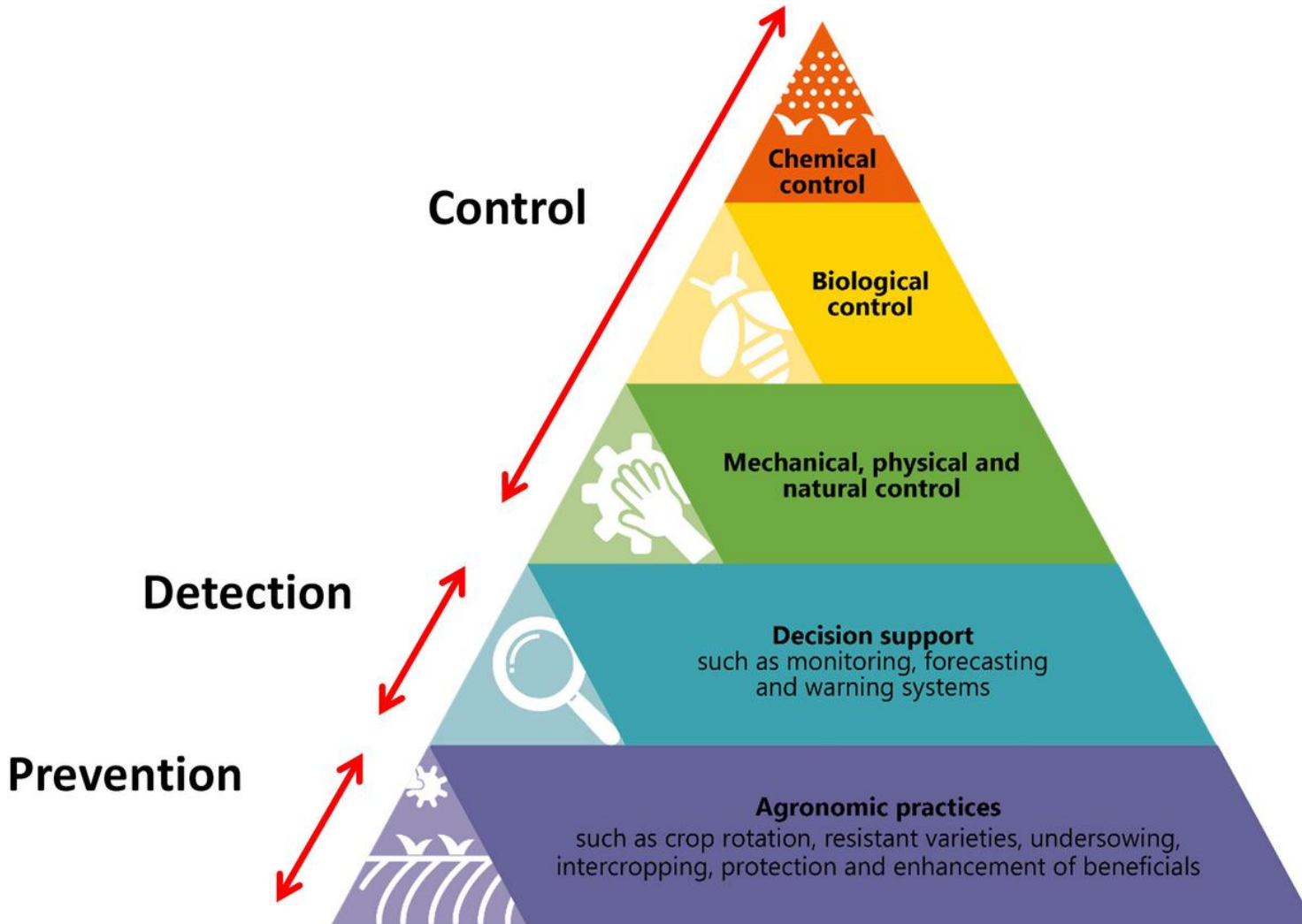
- Monitor **new virulent races** in farmer-led trials
- Molecular markers for **rapid detection of pathogen** race structure
- Develop a new **decision support tool** for fungicide application guidance

3. Grower-led platform to share skills, resources and foster understanding

- Farmer-led field trials providing **pipeline of OSR traits** to industry
- Knowledge exchange and **stakeholder engagement campaign**, working with AHDB



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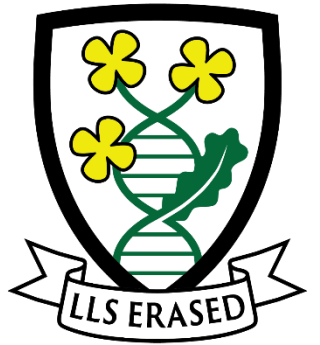
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The research programme

CONSUMER QUANTITATIVE SURVEY

n=200

Consumers of rape seed or vegetable oil. Participants from a paid UK panel provider.

 1st September 2026

 Quotas to match UK region, age and gender

 Members of panel with verified UK address / IP locations. 98.5% participants main shopper.

 Statistically representative of age and gender; with sub-segments statistically robust.

 Regions, Income and Chief Income Earner designations are representative only; the majority cannot be analysed independently due to small segment size. Grouping into larger categories (i.e. North of England) yields statistically robust results.

GROWER QUANTITATIVE SURVEY

n=120

Farmers growing OSR for harvest 2027, or harvested in the last 3 years (88%)

 3-4 Sep 2026

 UK farmers aligned to arable geographic laydown. Members of the pre-verified Five Bar Gate panel.

 Lead decisions makers or significant influence over decisions. 14% (n=17) registered seed growers. 70% said LLS was a 'slight problem' showing good awareness. Across respondents, 56% of 2027 harvestable area will be used for Vegetable Oil, and 22% for Animal Feed / Vehicle applications.

 Statistically robust at a macro level, but reduced confidence in some smaller segments

 Representative across farm sizes, education & age

policy makers and farmers is critical. This conference brings together leading voices from across the precision breeding landscape to explore how Precision Bred Organisms (PBOs) can deliver real-world impact. The programme will showcase scientific advances, explore routes to market, and address the regulatory and practical steps needed for adoption at scale.

Speakers and participants

Session 1: Science, Policy and Impact

Anne Ferguson-Smith OBE FRS, Executive chair, Biotechnology and Biological Sciences Research Council; Cristóbal Uauy, Director, John Innes Centre; and senior Defra representative (TBC.)

Session 2: The UK Advantage? Accelerating PBOs from Discovery to Farm-Scale Evaluation

Perry Bateman, Head of Science at British Sugar; Andrew Walker, Vice President, Commercial at Cibus; Simon Griffiths, Group Leader, John Innes Centre; and Tom Allen-Stevens, Founder and Farmer, British On-Farm Innovation Network (BOFIN).

Session 3: Bringing PBOs to Market

Peter Eastmond, Principal Research Scientist, Rothamsted Research; Cathie Martin FRS, Group Leader, John Innes Centre; Agnieszka Witek, Lead Scientist, BioPotatoes; and Andrew Dominy, Vice President, Product Management, Tropic.

Panel: Authorisation and Beyond - Navigating Next Steps

Adekunle Adeoye, Policy Advisor for Genetic Technologies, Food Standards Agency; Margaret Wallace, Joint Head of Crop Characterisation, NIAB; Louise Everest, Technical Officer, British Society of Plant Breeders; and Ed Barker, Head of Policy and External Affairs, Agricultural Industries Confederation; and Helen Gillen, Regulatory Manager, Food and Drink Federation.

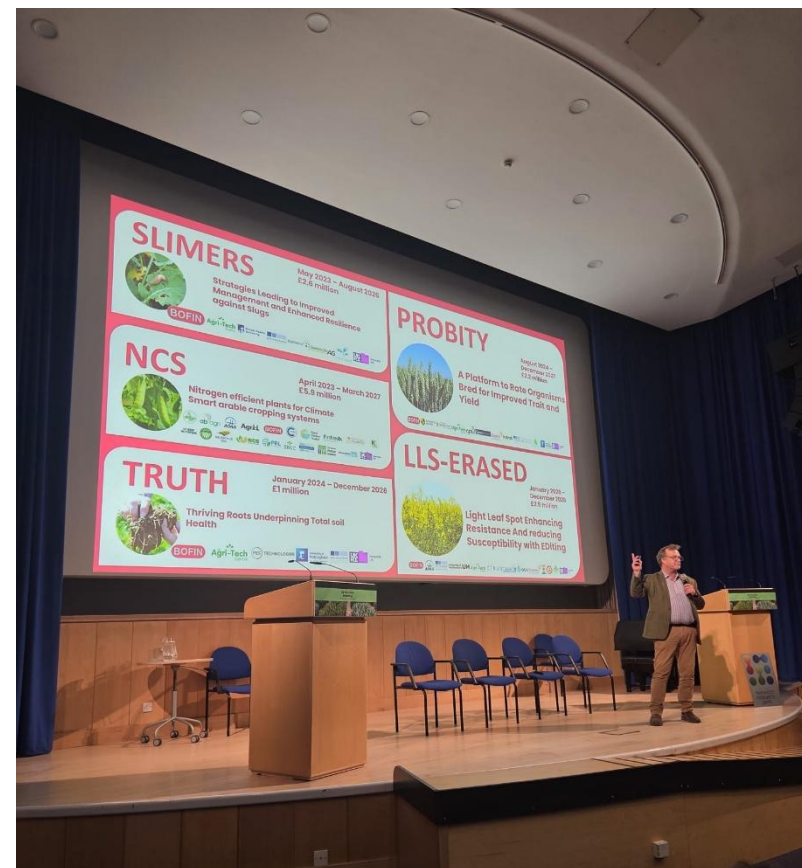
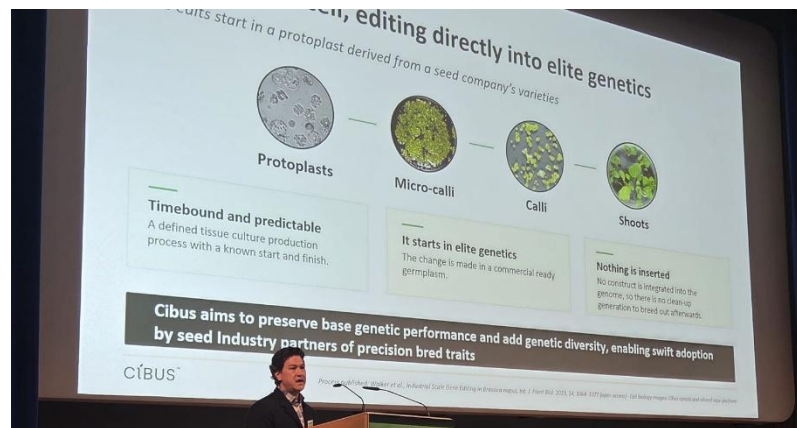
Session 4: Ecosystems to Enable New Frontiers

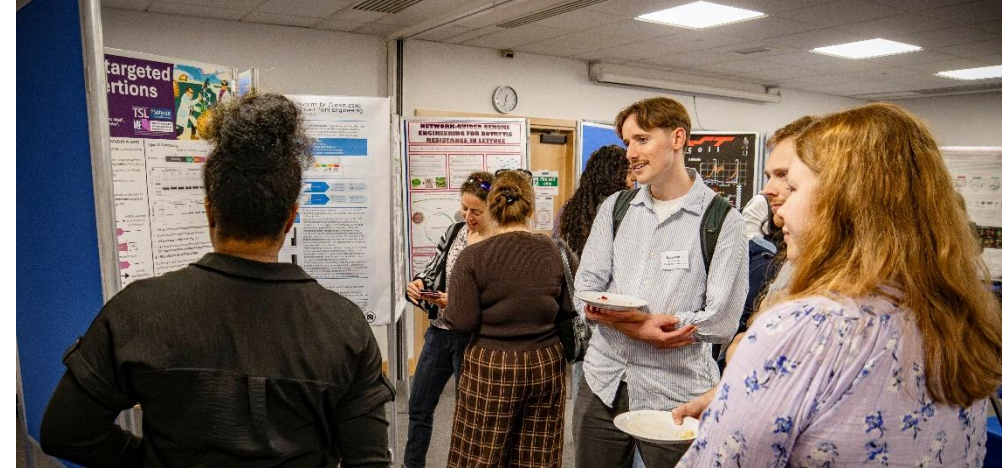
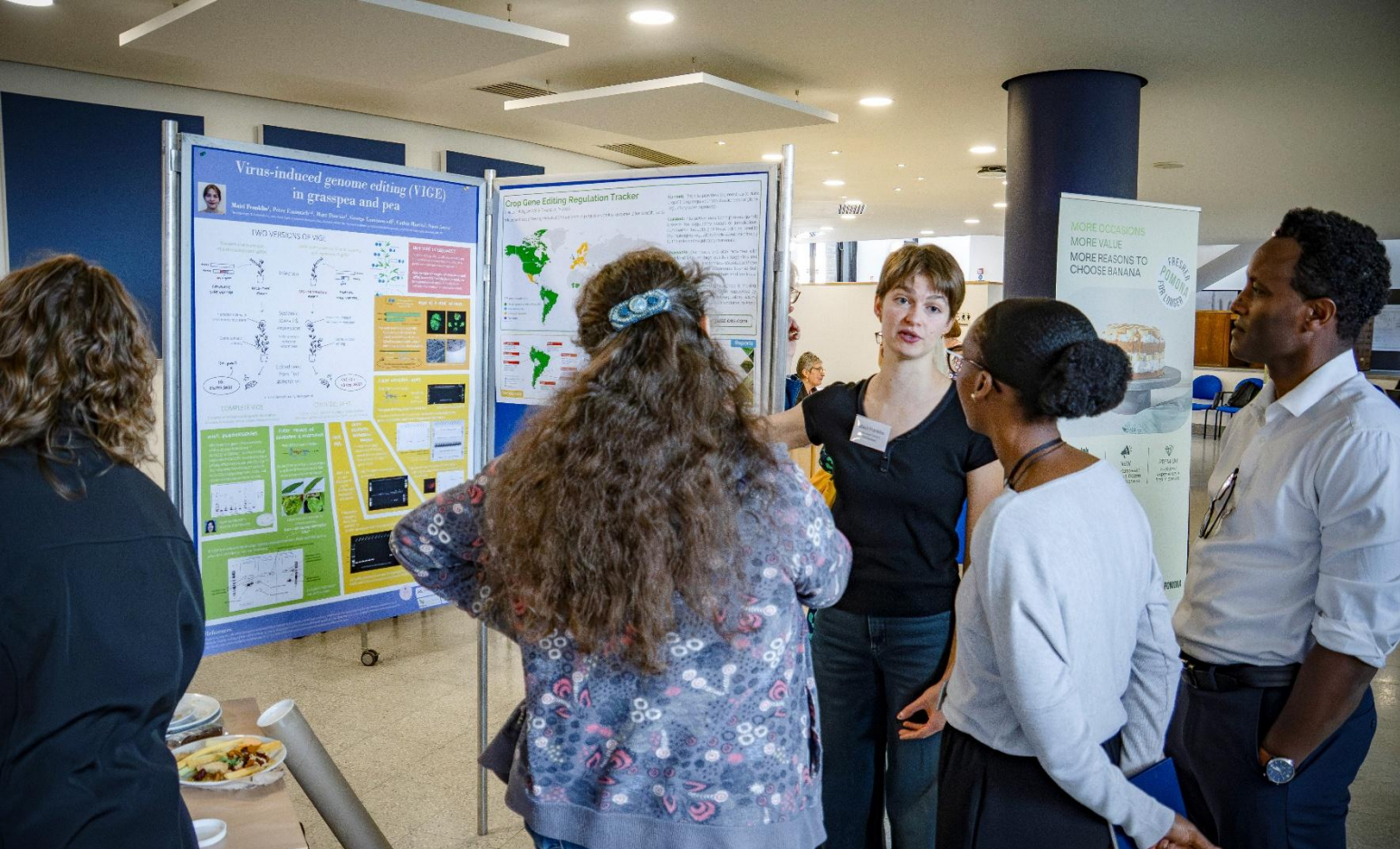
Jonathan Jones FRS, Group Leader, The Sainsbury Laboratory; Samuel Gattis, Chief Technology Officer at Wild Bioscience; and Roz Bird, CEO, Anglia Innovation Partnership.

Panel: Celebrating Success - Unlocking Future Opportunities

Duncan Ribbons, Chief Legal Officer, Tropic; Ofir Meir, Co-founder and CEO, QuiberTech; Felicity Knowles, COO and Co-Founder, Trait Seq; and Elisa Arthofer, Head of Business Development, Resurrect Bio.

Closing Reflections: Next steps and our collective ambition for advancing precision breeding in the UK.





- More than 240 delegates from over 100 organisations
- Research, farming, industry, government, regulation, policy and investment communities
- Very good coverage on LinkedIn
- Positive feedback across the event
- Press releases and summary report underway
- Feedback form to capture outcomes and lessons learned

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3d

What stood out from this year's UK Precision Breeding: Farming Futures Conference?

Last week, our Agricultural Specialist [Owen McIntosh](#) joined 240 attendees from more than 100 organisations at [Norwich Research Park](#) to hear about the research, regulation and commercial realities shaping precision breeding in the UK.

There was plenty of optimism about the UK's position in precision breeding, with a strong research ecosystem and some fascinating examples of where the technology is already heading.

But there are significant questions too.

From uncertainty around UK-EU trade and regulation, to questions around labelling and consumer communication, and the challenge of turning research into commercially available crops, one thing came through particularly strongly: researchers, policymakers, industry and farmers all need to be part of the conversation.

And farmers want to be involved early, not simply when a new crop is ready to reach the field.

We've pulled together some of the points that stood out to Owen from the day. Swipe through for his takeaways ➡

[#PrecisionBreeding](#) [#PlantBreeding](#) [#CropScience](#) [#AgriculturalResearch](#)



 **Ben Goldsborough**
1w

The future of food is being developed right here in South Norfolk.

I spent two hours this week at the UK Precision Breeding – Farming Futures Conference at [Norwich Research Park](#), hearing from scientists, farmers, industry and Government about how we turn world class research into real change on farms.

Precision breeding could play a hugely important role in improving crop resilience, tackling disease, supporting sustainable food production and strengthening food security.

We have a first mover advantage in the UK. We cannot afford to lose it.

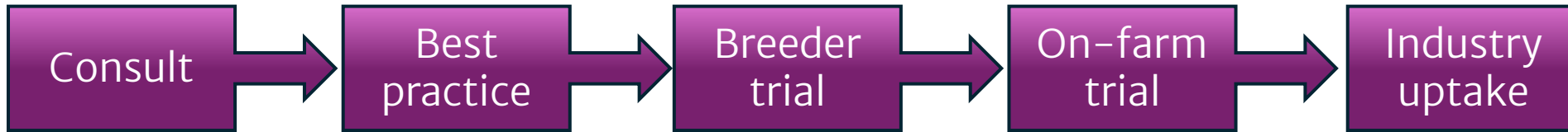
South Norfolk is already a global hub of excellence for this technology. Government must do everything it can to support the research, skills, infrastructure, investment and sensible regulation needed to keep us at the forefront.

The science is here. The opportunity is here. Now we need the ambition to make the most of it.

[#PrecisionBreeding](#) [#FoodSecurity](#) [#Agriculture](#) [#Innovation](#) [#Science](#)
[#NorwichResearchPark](#) [#SouthNorfolk](#) [#UKAgriculture](#) [#PlantScience](#) [#GeneEditing](#) Dr Penny Hundleby CSci, FRSB Cristóbal Uauy Emma Phillimore Anne Ferguson-Smith Perry Bateman Andrew Walker simon griffiths Tom Allen-Stevens John Innes Centre British On-Farm Innovation Network (BOFIN) The Sainsbury Laboratory Earlham Institute Quadram Institute University of East Anglia British Sugar Cibus



Looking beyond LLS – mapping the route to market

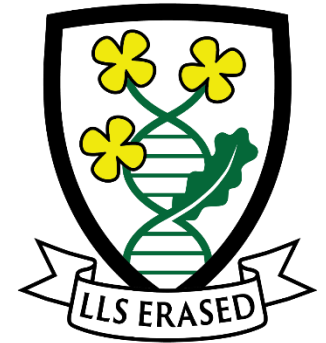


Output:
Lessons learnt:

LLS resistant near market germplasm
Challenges and opportunities
Understanding of the landscape
Development of practices and process
Building of consumer confidence

Acceptance:

Rapid streamlining of adoption of future traits –
Verticillium, stem canker, cabbage stem flea beetle,
designer oils



Innovate
UK

Acknowledgements

MAQBAT – ERA
CAPS PROJECT

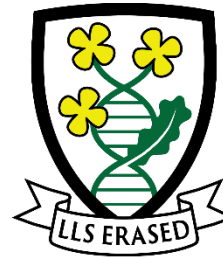


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Hertfordshire **UH**



Henrik Stotz
Yongju Huang

Laura Gimenez Molina
Heather Fell
Ajisa Muthayil Ali



Eyerusalem Morka

JIC Platforms



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