



# The Advanced Plant Growth Centre – Accelerating Breeding and Management to Safeguard UK Horticulture

**Rob Hancock**

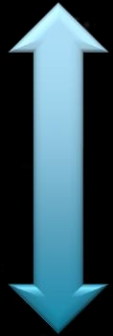
**Cell & Molecular Sciences**



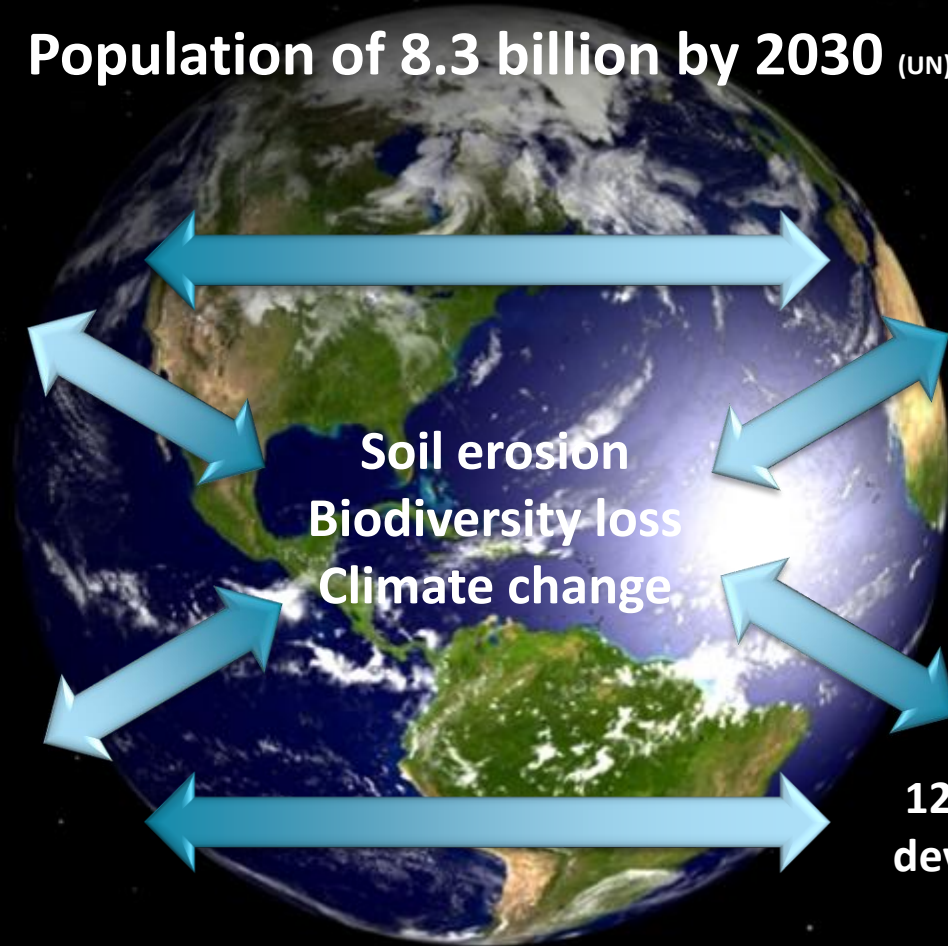
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# Population of 8.3 billion by 2030 (UN)

**Food**  
50% increase in  
demand (FAO)

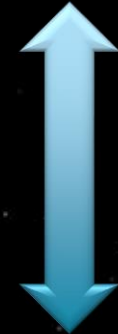


**Freshwater**  
30% increase in  
demand (FAO)



**Soil erosion**  
**Biodiversity loss**  
**Climate change**

**Energy**  
50% increase in  
demand (EIA)



**Land**  
120 million ha needed in  
developing countries crop  
production (FAO)

## NEWS

Home | War in Ukraine | Cost of Living | Coronavirus

Science & Environment

### How Pakistan floods a climate change

By Georgina Rannard  
BBC News Climate and Science

4 days ago

Climate change



## NEWS

Home | War in Ukraine | Asia | Australia | Europe

### Europe's drought the worst in 500 years - report

23 August

Europe heatwaves



From: [Environment Agency](#)  
Published 30 August 2022

#### Press release All of England's South West region now in drought

Bristol, Somerset, Dorset, south Gloucestershire and parts of Wiltshire have now moved to drought status.



### UK weather: Met Office warns of 'dangerous' floods across country

Yellow thunderstorm warning follows weeks of drought caused by extreme heat and little rainfall

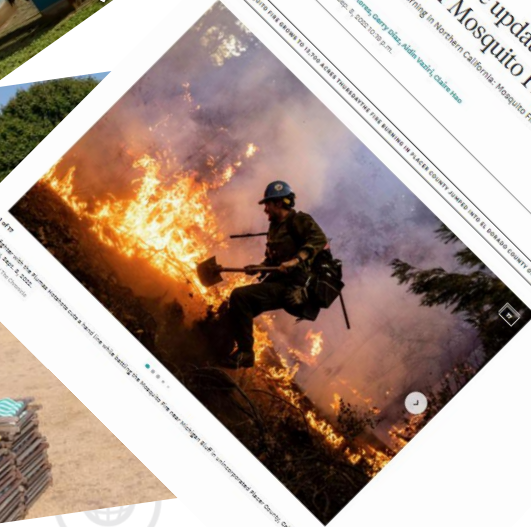


Football pitch in Maidenhead, Berkshire. Photograph: [Ben Brumby](#)  
"dangerous" flooding this week  
casters have warned.

### California fires live updates: Newsom declares state of emergency over Mosquito Fire, Fairview Fire

Latest updates on active fires burning in Northern California: Mosquito Fire in Placer County, Redford Fire and Fairview Fire near

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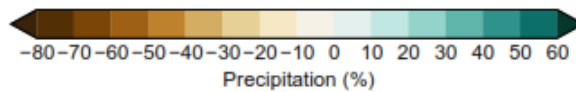
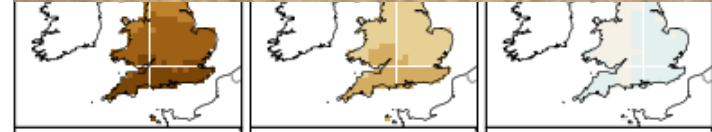
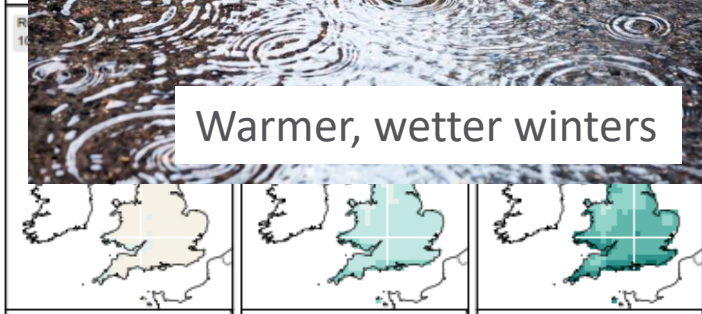
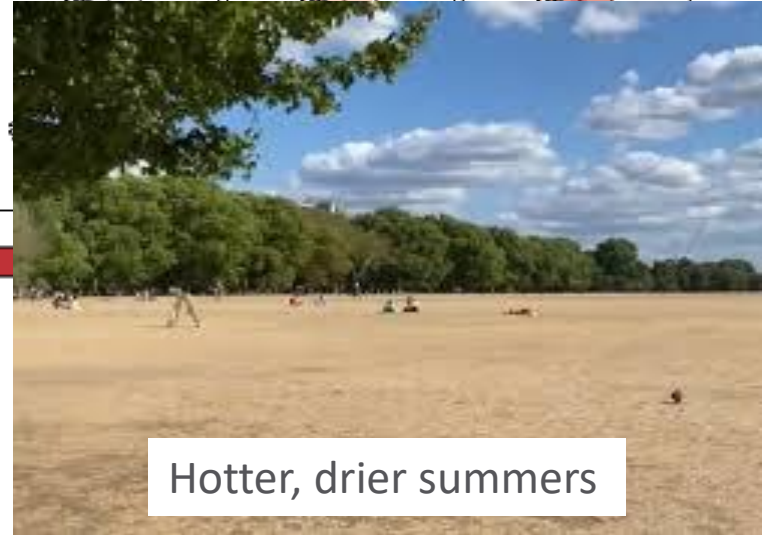
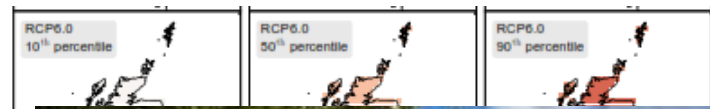
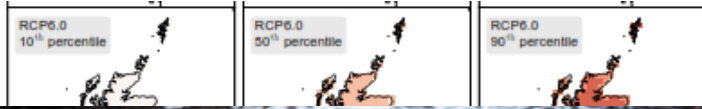
James Online



# UK climate anomaly 2080-99/1980-2000



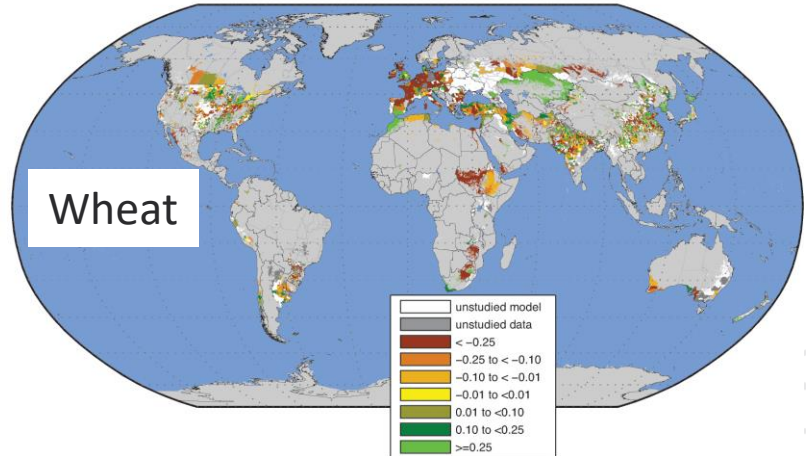
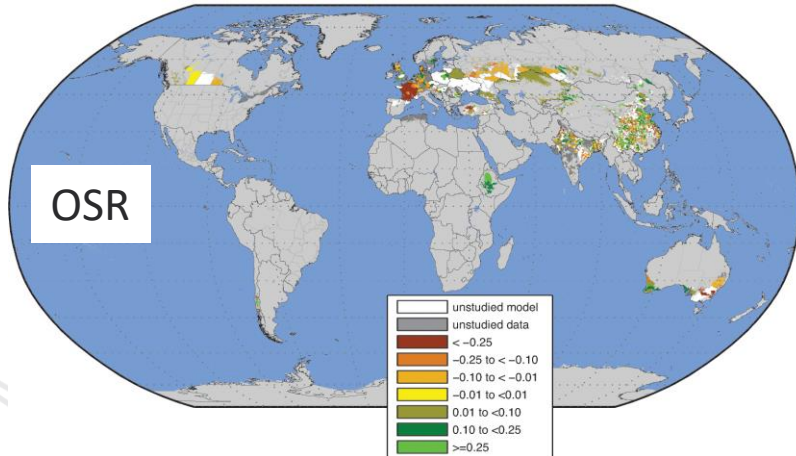
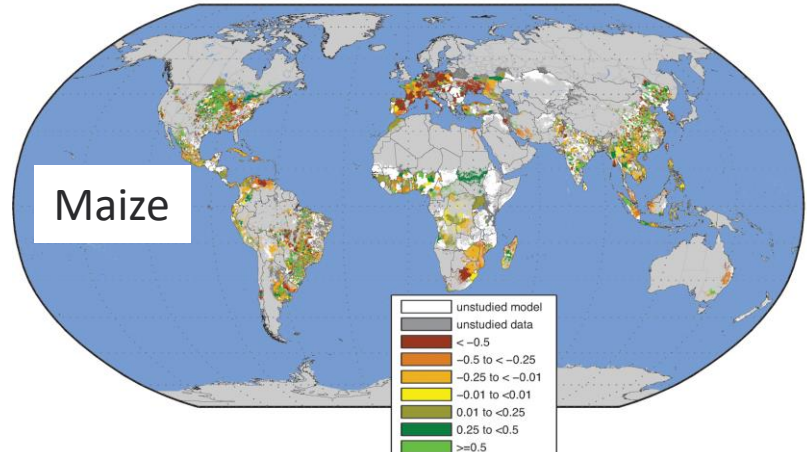
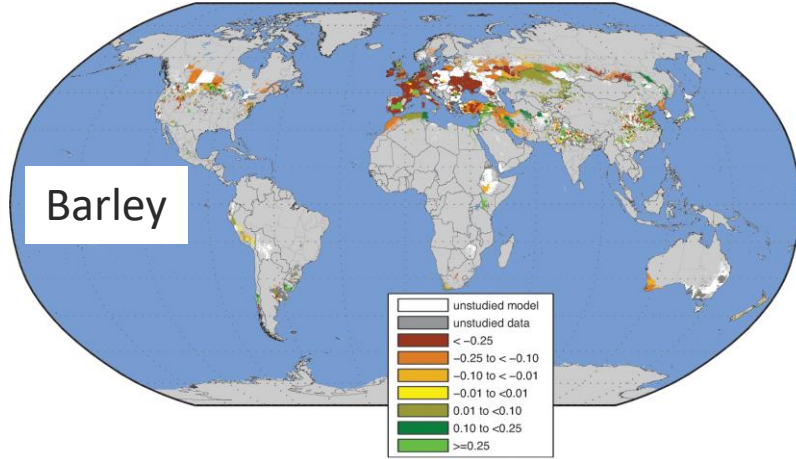
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# Crop Yields are Already Affected



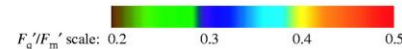
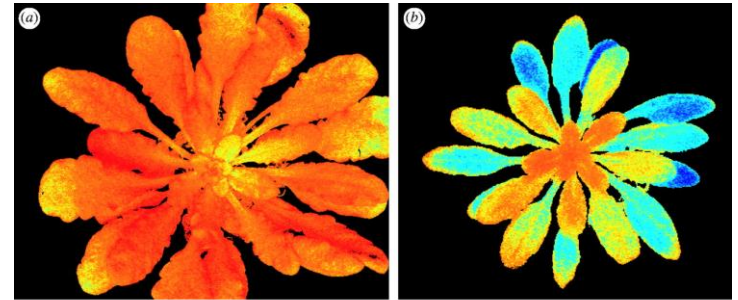
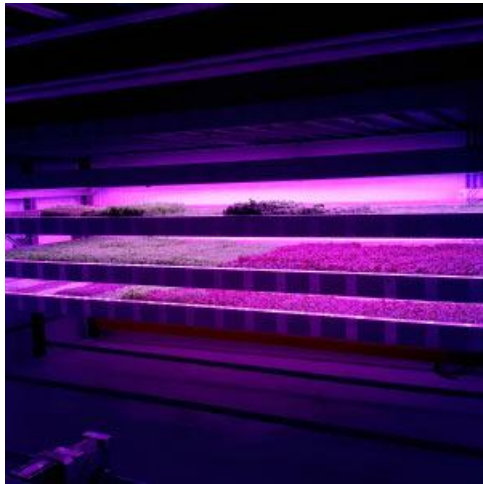
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# The Advanced Plant Growth Centre



A £27M capital project that seeks to use **next generation controlled pre- and post-harvest environments** combined with **high throughput technologies** to assess plant performance to deliver the **underpinning science** that will lead to **new crop varieties** that can feed a growing population in the face of environmental change and support technologies that **provide varieties and management systems** to support the emerging industries of precision and controlled environment agriculture.



# APGC Core Facilities and Objectives

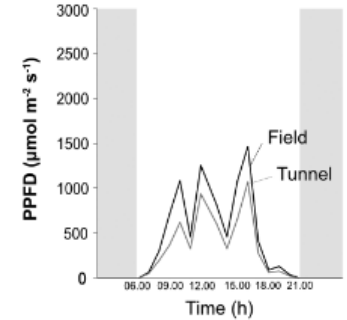
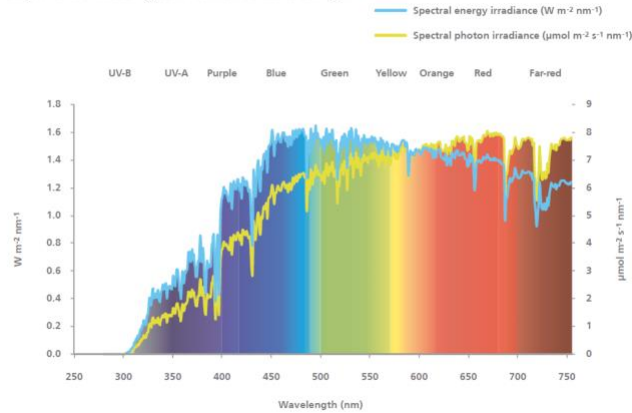


- Climate change – how will predicted climates influence crop productivity?
- Pathogen responses to environmental change – predicting pathogen pressure and crop pathogen interaction
- Predicting and modelling impacts on natural ecosystems and ecosystem services
- Climate change mitigation – breeding climate resilient crops
- Precision agriculture – development of sensors and knowledge to guide crop management
- New farming technologies – developing varieties and techniques for indoor agriculture
- New crops – optimising systems for non-food crops e.g. pharma

# Next Generation Controlled Environments



Valoya NS12 creates a light environment similar to sunlight



- Independent control of air and substrate temperature
- Control of gas composition ( $CO_2$ ,  $O_2$ ,  $O_3$ ,  $NO_x$ ) and humidity
- Dynamic light spectrum control to replicate solar radiation
- Dynamic light intensity control to replicate cloud dynamics and plant-plant shading





# Next Generation Controlled Environments



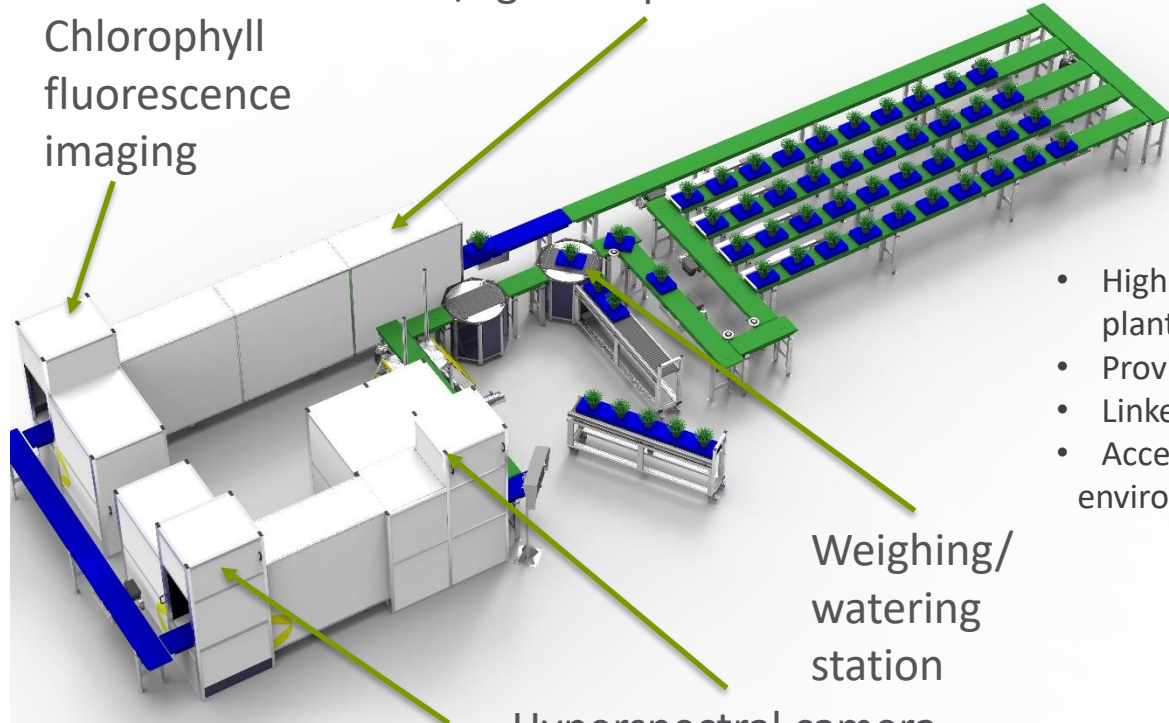
Replicate global environments both present and future



# High-Throughput Phenotyping Platform

Dark/light adaptation tunnel

Chlorophyll  
fluorescence  
imaging



- High throughput non-destructive imaging of plants
- Provides real time readout of plant performance
- Linked to genetics accelerates gene discovery
- Accelerates breeding of cultivars adapted for local environments

Weighing/  
watering  
station

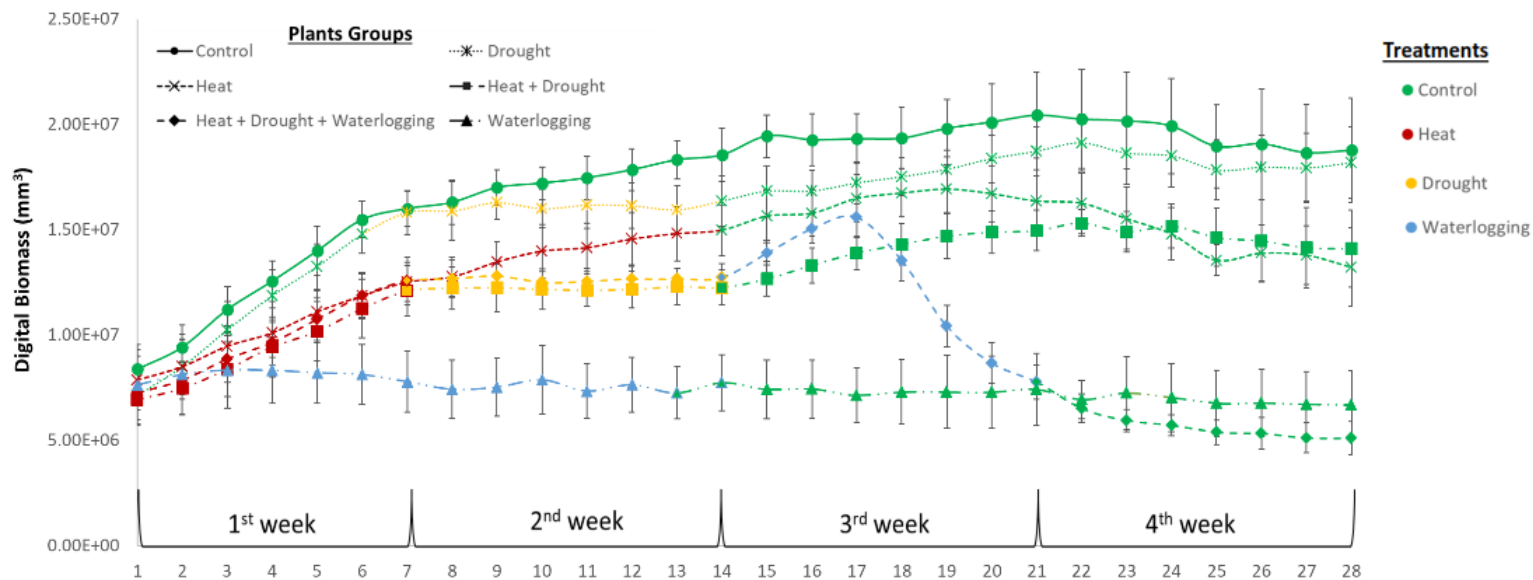
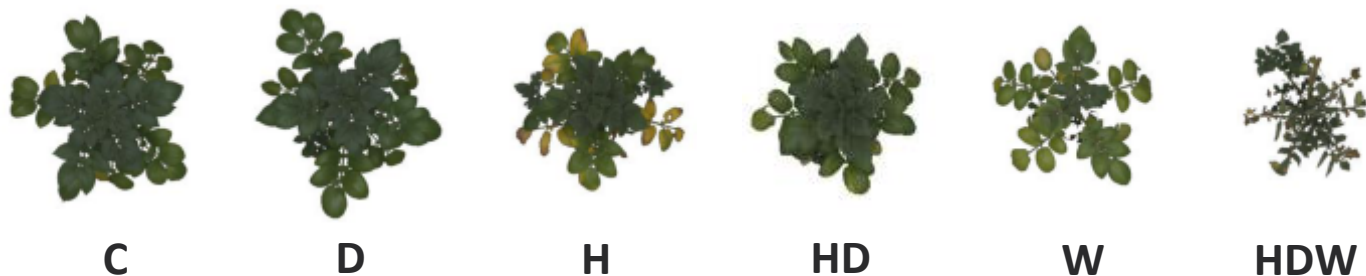
Hyperspectral camera

RGB camera

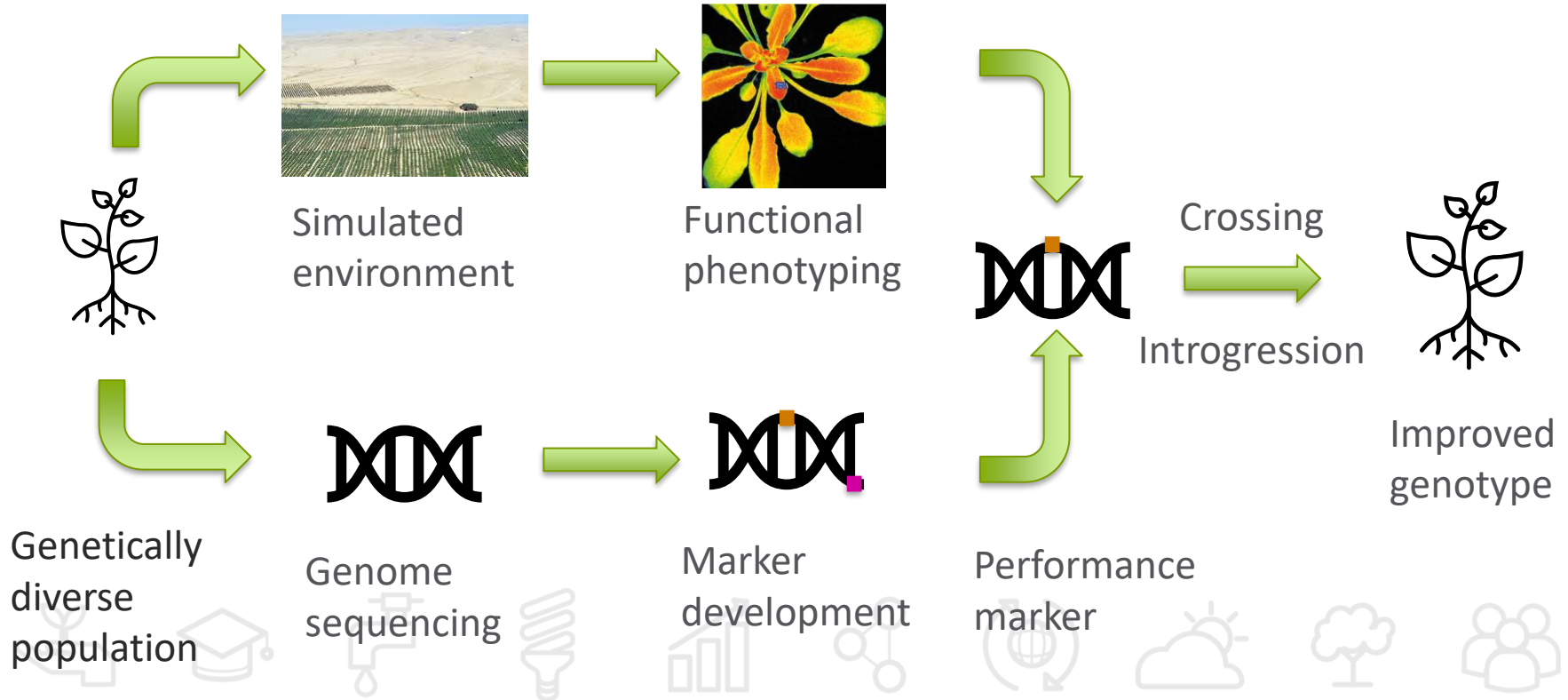




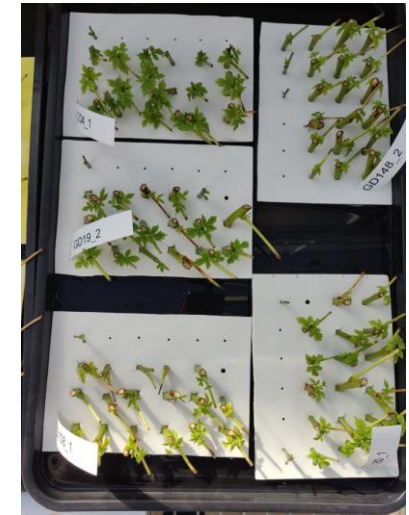
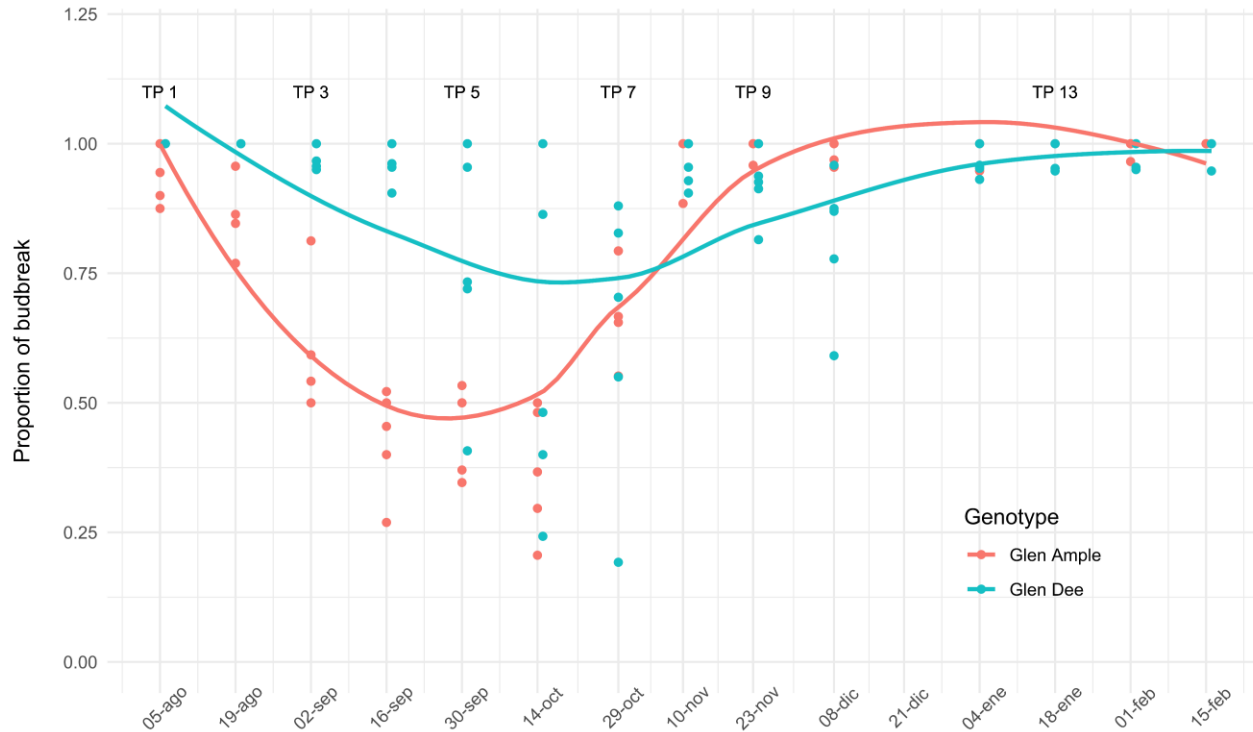
# High-Throughput Phenotyping Platform



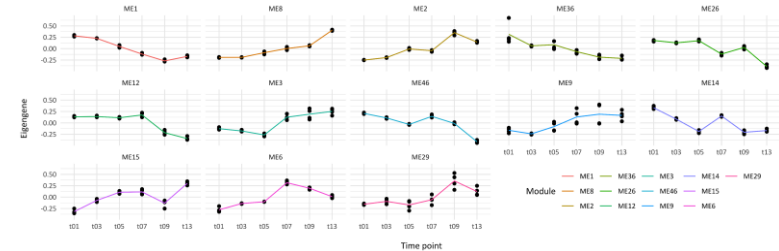
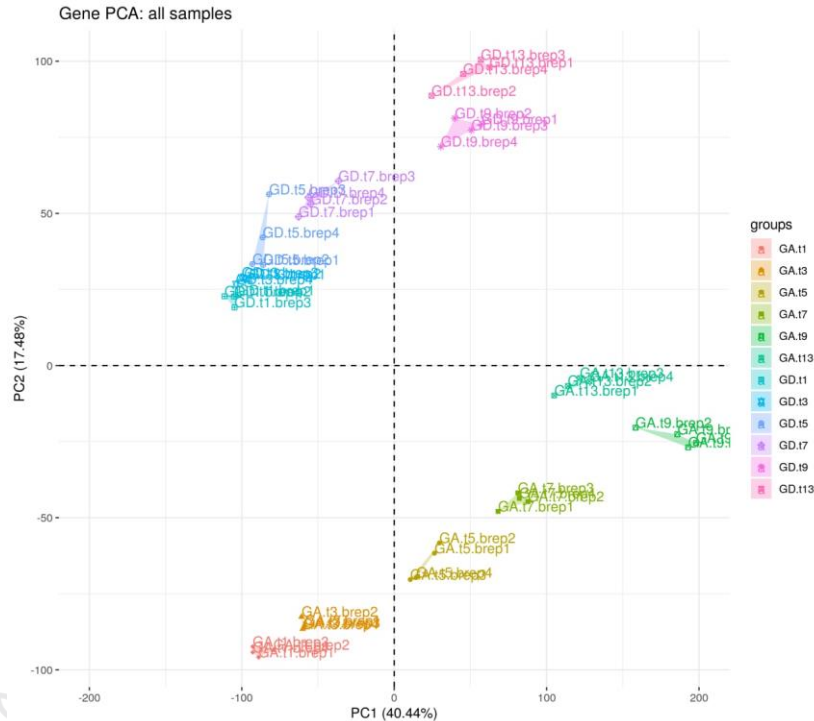
# Accelerated Breeding of Adapted Crop Genotypes



# Identification of Markers for Dormancy Requirements in Raspberry



# Identification of Markers for Dormancy Requirements in Raspberry



- Genes clustered by Ample expression patterns
- Seek differences/absences in Glen Dee
- Key candidate genes identified
- Validated in Ample/Dee mapping population



# Identification of Markers for Dormancy Requirements in Raspberry



- Population created from Glen Dee (low chill) x Glen Ample (high chill)
- Cross conducted in 2021
- Material collected and genotyped for markers
- Map construction underway
- Dormancy phenotyping Autumn/Winter 2023/24





# Improving the Efficiency of Indoor Agriculture for Food Security

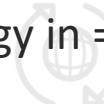
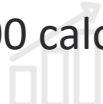
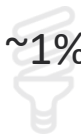
- High density
- Year round production
- Climate independent
- Consistent quality
- Automation potential
- Water use efficiency
- Pest & disease control
- Environmental trait manipulation
- Capital costs
  - Financial
  - Environmental
- Energy costs
  - LUE
  - Architecture
  - Cropping cycles
- Chemical inputs
- Poorly adapted varieties



Data per kg lettuce	Water use (L/kg)	Crop Yield (kg/m <sup>2</sup> /y)	Food Miles
Open Field	250	3.9	2000
Glasshouse	20	41	500-1000
Vertical Farm	1	80-120	50

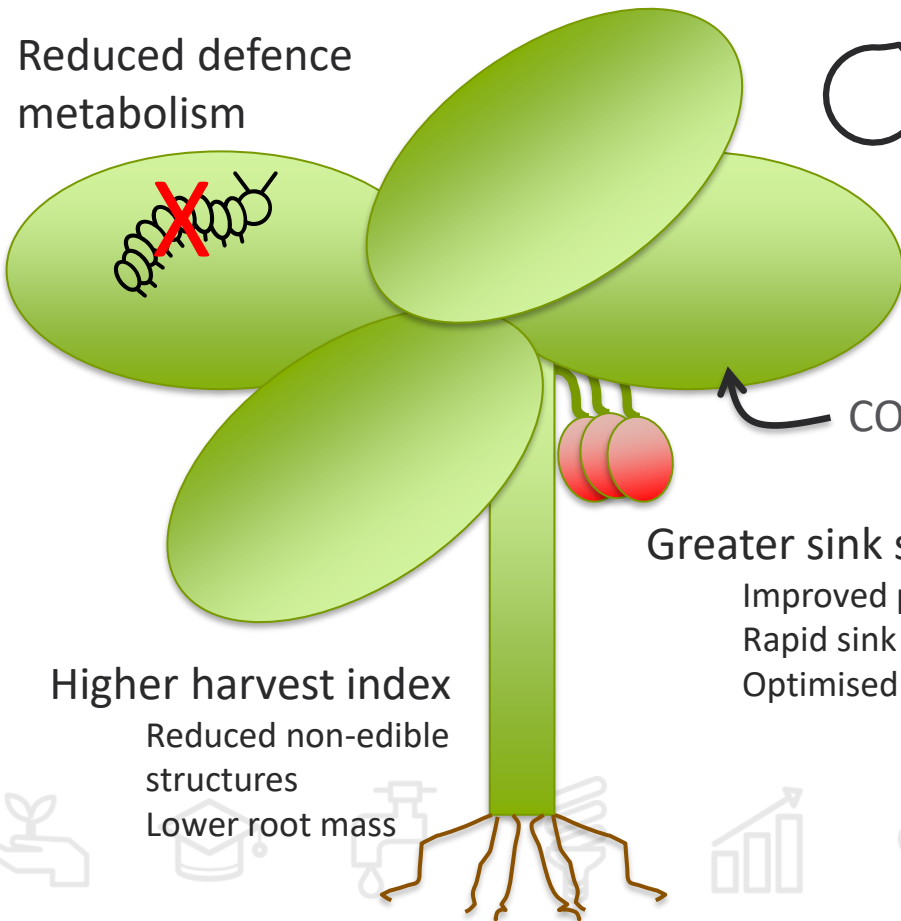
**BUT.....**

Light use efficiency ~1% - 100 calories of energy in = 1 calorie of biomass



# Breeding the Ideal Indoor Crop?

Reduced defence  
metabolism



Optimised LUE

Leaf architecture  
Light harvesting complex  
Photosynthetic electron transport

Improved CO<sub>2</sub> assimilation

Higher stomatal density  
Increased mesophyll conductance  
Improved RuBisCo kinetics

Greater sink strength

Improved phloem connectivity  
Rapid sink development  
Optimised sink numbers

Higher harvest index

Reduced non-edible  
structures  
Lower root mass



Innovate  
UK



Horizon 2020  
European Union funding  
for Research & Innovation



Biotechnology and  
Biological Sciences  
Research Council



The James  
Hutton



HM Government



Scottish Government  
Riaghaltas na h-Alba  
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