

# Miscanspeed

## Genomic Selection & Speed Breeding to accelerate the development of resilient Miscanthus varieties



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# Miscanthus research pipeline at IBERS



**Institute Strategic Program**  
Fundamental and strategic crop research



**Miscanspeed**  
Genomic Selection for accelerated Miscanthus breeding



**PBC4GGR**  
Addressing the barriers to the scale up of perennial biomass crops in the UK



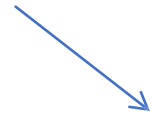
**Biomass Connect**  
Biomass Innovation and Information Platform  
UK Multi-Site Demonstrator



# Miscanthus Breeding



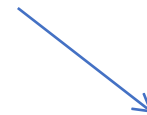
Diverse germplasm



Make crosses



Evaluate progeny &  
make selections



Multilocation trials



New varieties

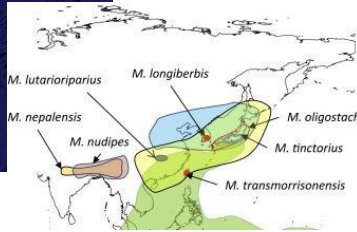
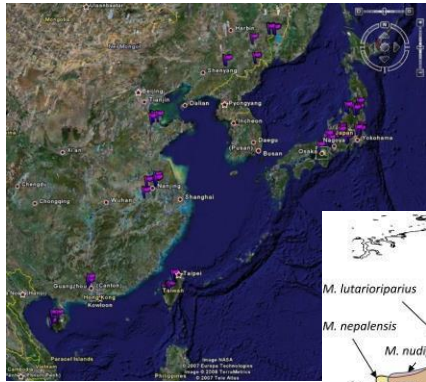
## Drivers:

We need RESILIENT Miscanthus genotypes to produce HIGH YIELDS, over 10-15 years, under FUTURE CLIMATES

We need DIVERSE genotypes, for a RESILIENT BIOMASS SUPPLY CHAIN



# Miscanthus breeding to date



*M. sacchariflorus*  
*M. floridulus*  
*M. sinensis*

Diverse germplasm

Make crosses



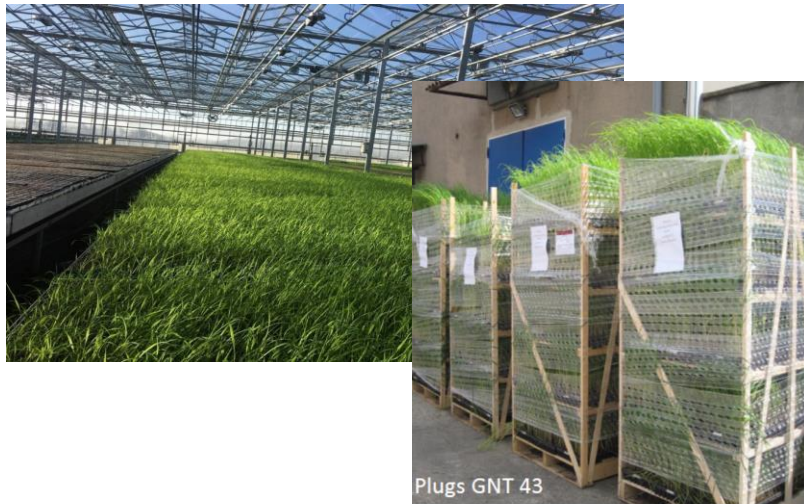
Evaluate progeny & make selections

Multilocation trials

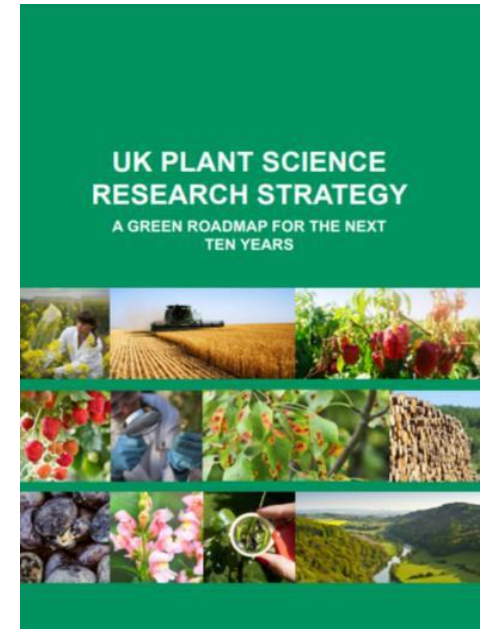


New varieties

Concurrent scale up of seed production & agronomy



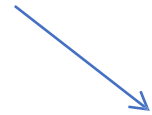
Plugs GNT 43



# Miscanthus Breeding



Diverse germplasm



Make crosses



Evaluate progeny &  
make selections



Multilocation trials



New varieties

## Challenges:

- Miscanthus plants take ~3 years to reach maturity, limiting breeding
- Phenotype is dependent on the environment – local, geographical, seasonal
- Different genotypes flower at different times
- Different species have different regulation

# Miscanspeed Breeding



#1 Combine phenomic and genomic data to generate a GS model

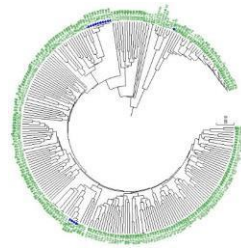
#2 Use the GS model to undertake recurrent selection based on genomic markers

This requires Speed Breeding (seed to seed in 1 year, not 3)

Recurrent selection populations

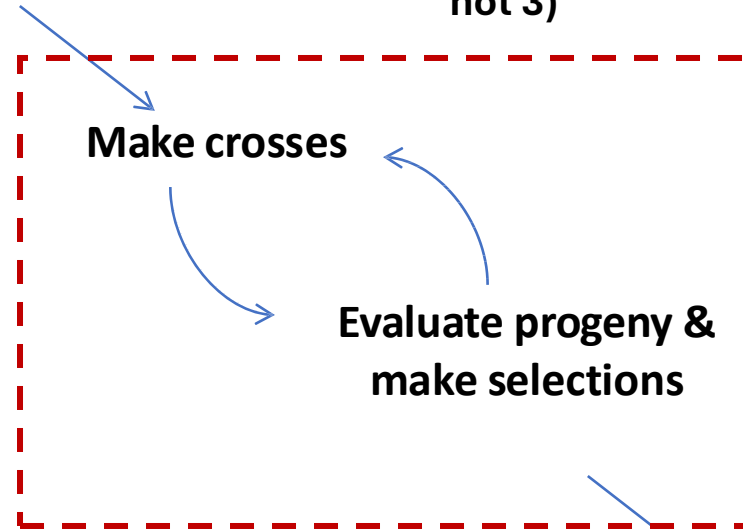


Phenotyping



Genotyping

Genotype-phenotype  
genomic prediction models

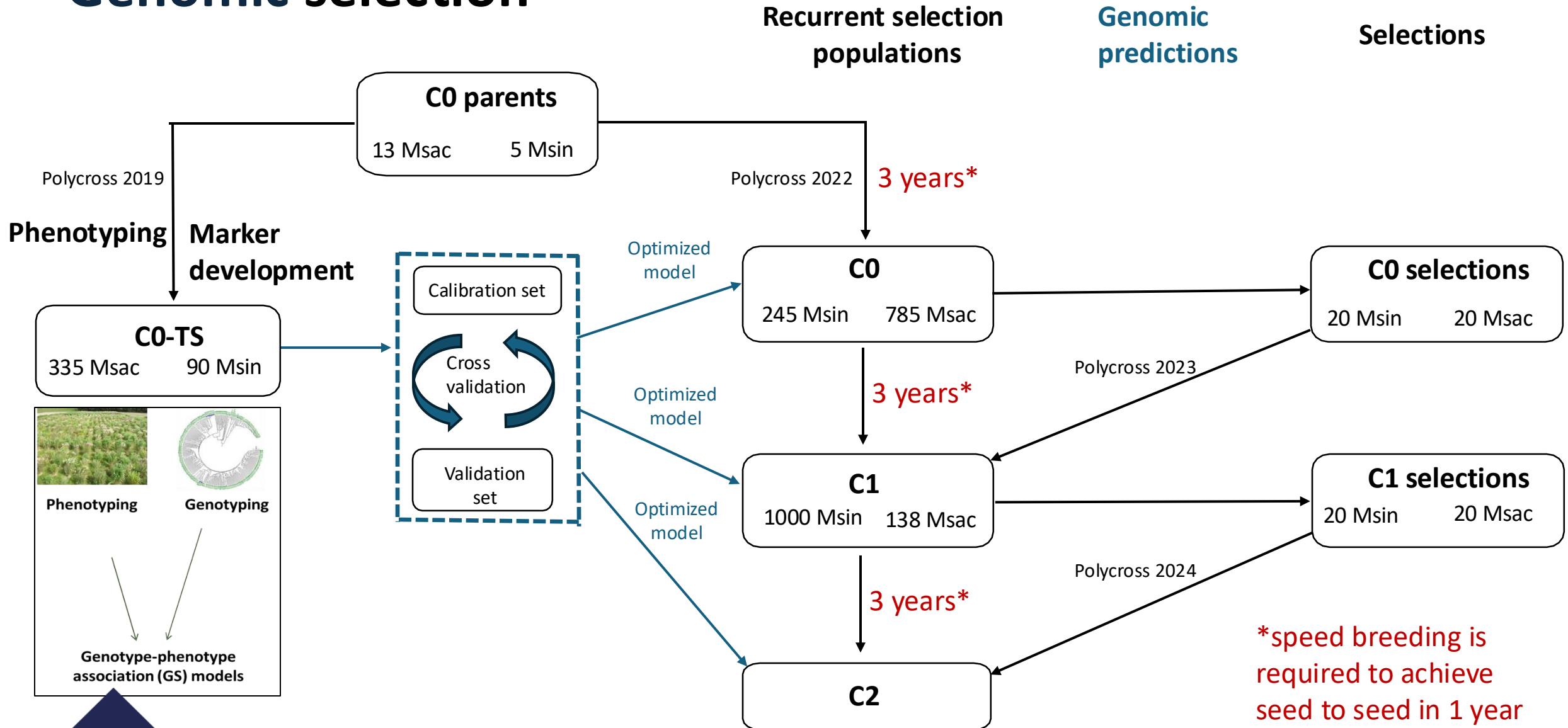


At seedling stage,  
based on markers

Multilocation trials

New varieties

# Genomic selection





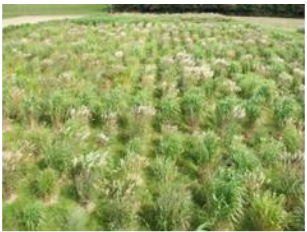
# Training Set: Miscanthus breeder's field, Germany (2021)



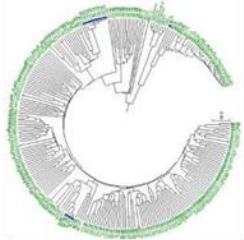
Within-species recurrent selection populations were established for Msin and Msac.

Seedlings were planted at JKI in Germany where they mature faster than in Aberystwyth.

Plants were genotyped Y2



Phenotyping



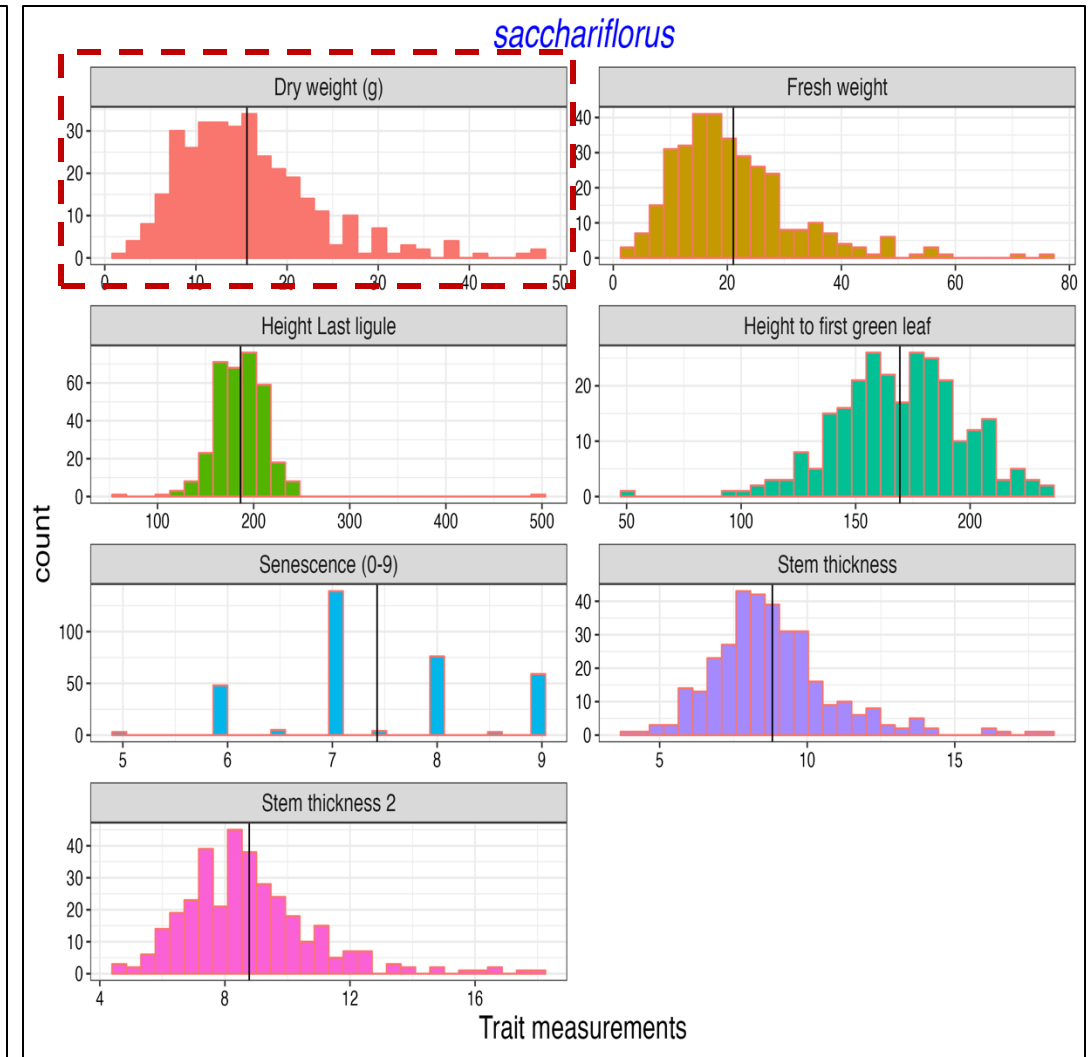
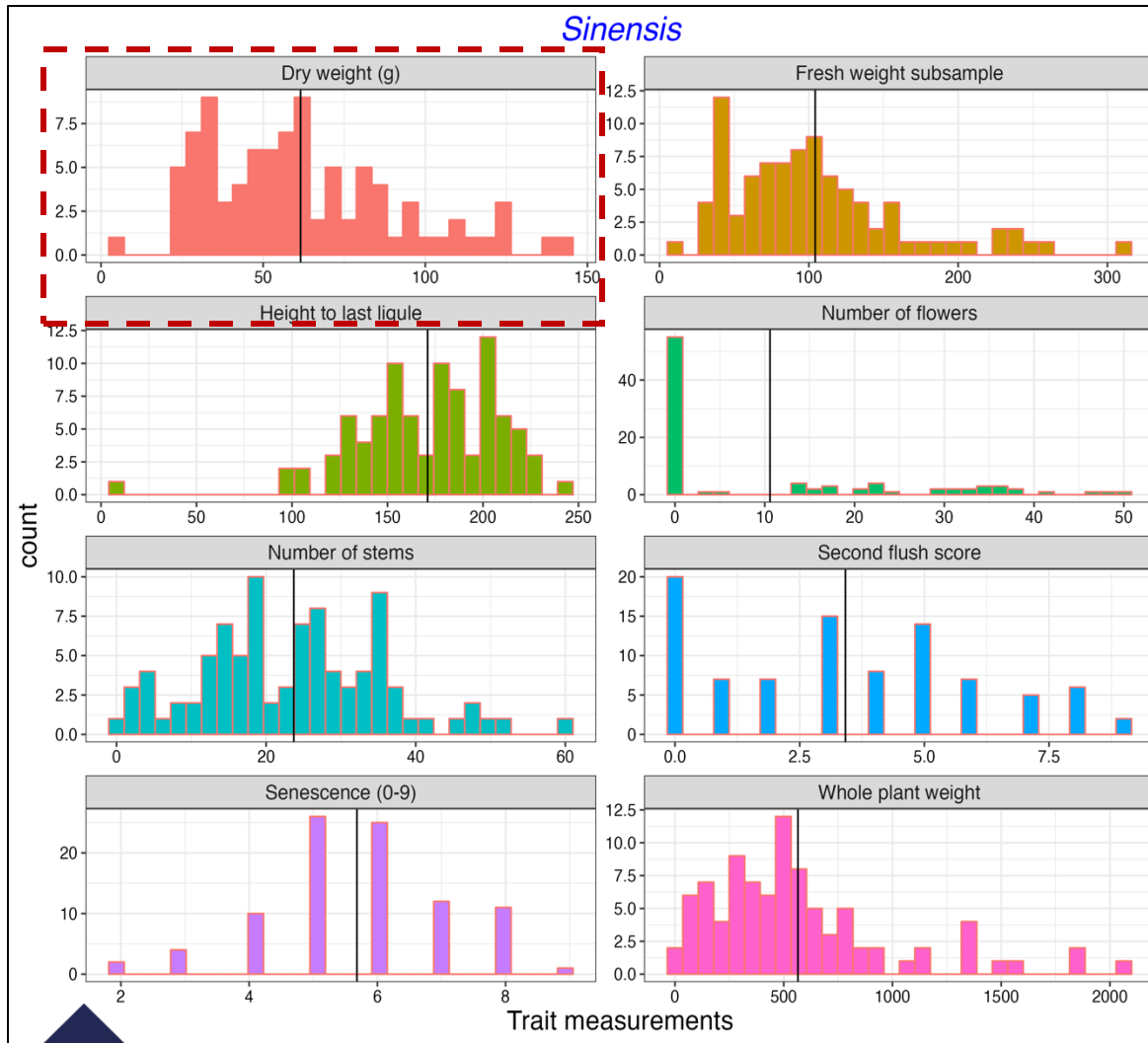
Genotyping

Phenotyping was completed in September 2022 & March 2023, and a marker set developed.

Trial re-planted in Aberystwyth for validation 2024/25



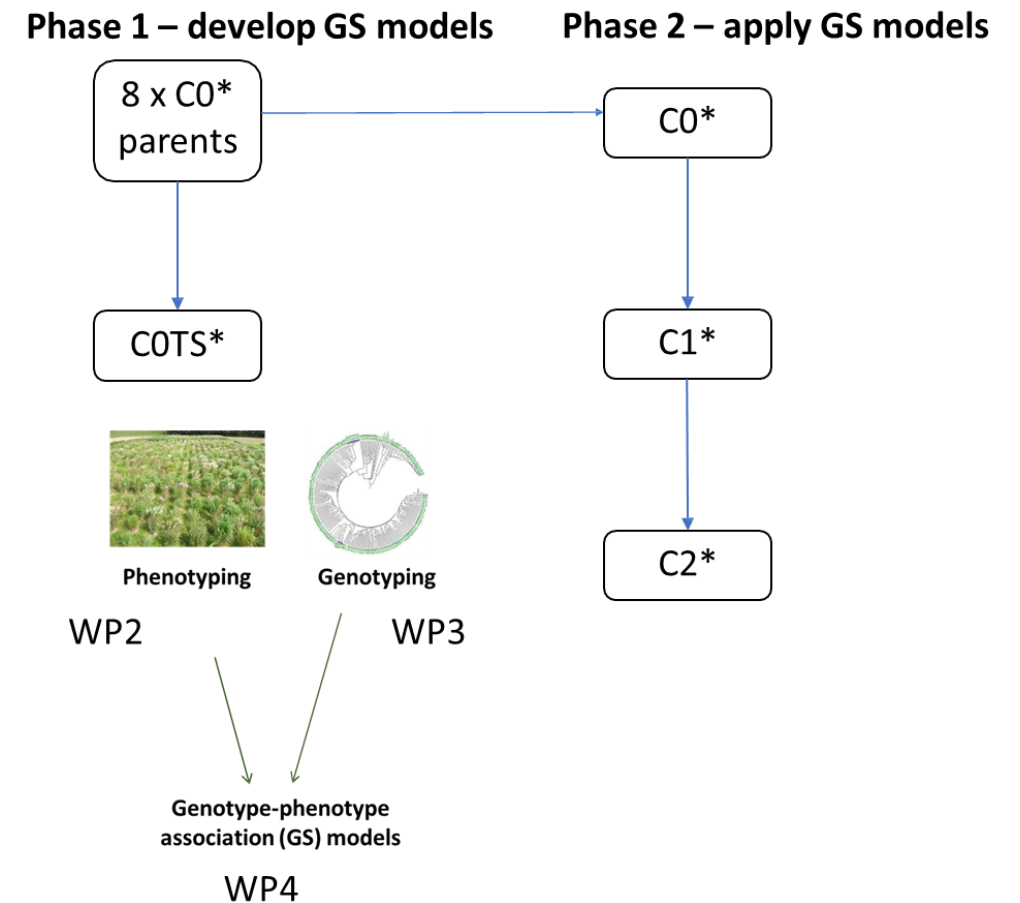
# Phenotypes





# Key Outcomes to date – GS models

- GS models for *M. sinensis* and *M. sacchariflorus* developed and implemented
  - For the first time in Miscanthus
- All Training Set phenotyping complete and plants established at Aberystwyth
  - multilocation validation
- Marker number analysis successful
  - GS cost reduction





# Speed breeding Miscanthus (seed to seed within 1 year)



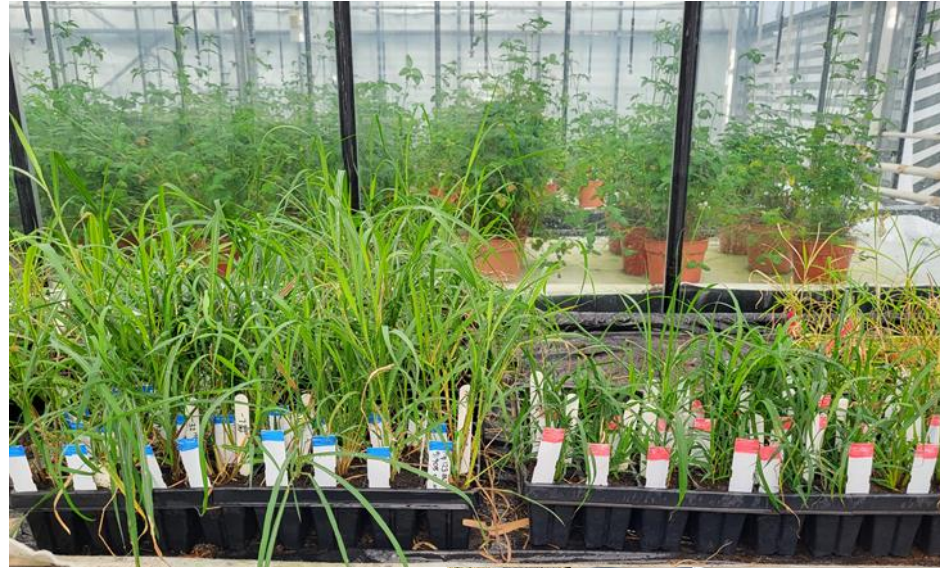
Determine the environmental conditions required for

- accelerated plant development
- flowering time
- seed set





# Seed and seedlings – El Hierro to Aberystwyth to El Hierro



1. Plants are sent to El Hierro and planted in crossing blocks
2. Seed are collected from plants grown on El Hierro and returned to Aberystwyth and germinated
3. Marker analysis is performed on seedling populations
4. Genomic prediction rankings are generated
5. Selections are made for crossing, and sent to El Hierro for crossing and seed production



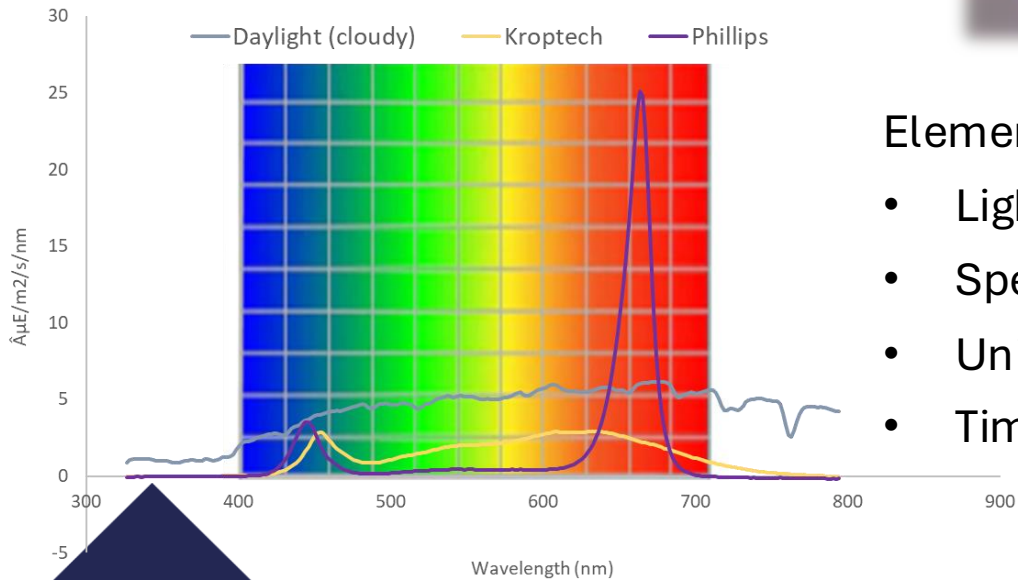
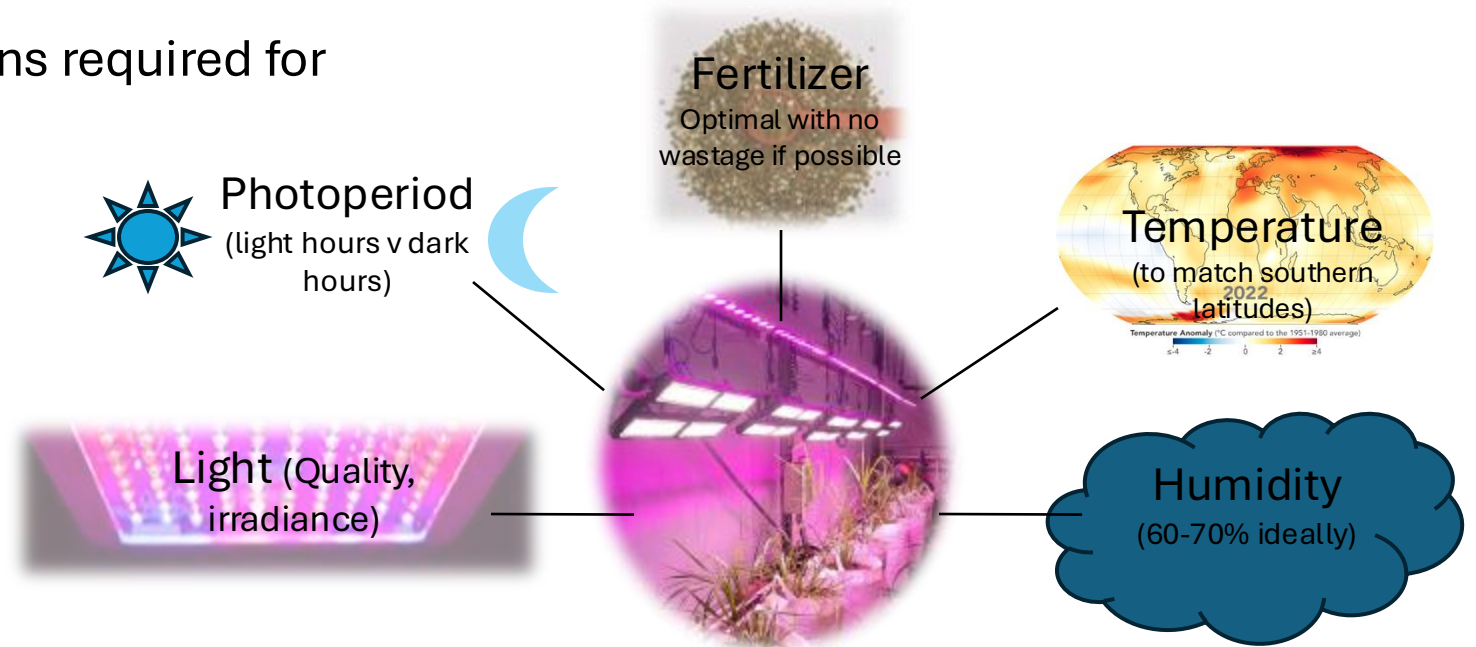


# Speed breeding Miscanthus in the UK



Determine the environmental conditions required for

- accelerated plant development
- flowering time
- seed set



Elements of a light recipe:

- Light level
- Spectrum
- Uniformity
- Timing



# Glasshouse customization for speed breeding, Aberystwyth



Ducting pipe for compartment cooling and ventilation

Phillips top lights producing efficient light wavelengths for optimal growth

Kroptech intra-canopy lighting, particularly for use when plants are larger to allow greater light interception further down the canopy

Chiller unit and insulated copper piping (See picture below) wrapped around grow bags for reducing thermal time to *Sinensis* plants to test effects on flowering time.



Automatic irrigation system, with back up irrigation controlled by moisture probes within growth medium. Osmocote slow release fertiliser mixed into the medium.

*M. sinensis* population in Aberystwyth Controlled Environment simulating El Hierro conditions, with additional chilling technology. *M. sacchariflorus* plants are planted in adjacent compartment under the same conditions, minus the chilling technology





## ***M. sinensis***

## ***M. sacchariflorus***

- Y1 *Unimproved growth environment*  
Flowering a few tens of seeds
- Y2 *with improvements*  
33 flowering panicles on 8 plants  
~2000 seed produced
- Y3 *Temperature*  
Significant flowering difference  
– can regulate flowering to make hybrids

- Unimproved growth environment*  
No flowering
- with improvements*  
Significant vegetative growth, 1-2 flag leaves
- Additional FR LEDs*  
Significant flowering  
Hoping for good seed set





# Key Outcomes to date – crossing and seed production

- C0 seed recreated on El Hierro, sent to Aberystwyth, grown at Aberystwyth, selected, and sent to El Hierro for C1 seed production, repeated for C1 seed.
  - seed to seed in 1 year!
- Glasshouses customised to modify Miscanthus growth, flowering and seed set
  - Flowering time is consistent between the customised glasshouse and El Hierro.
  - Msin seed set in Y2, Msac seed set in Y3 following additional modifications.
  - Temperature regulation of flowering time in Msin

Crossing and seed production



WP6



WP5





# Project team

**Kerrie Farrar** - *Project lead*

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**Caron Jones, Sian Davies** - *Project managers*

**Beatrice Ifie, Chris Ashman, Chris Glover** - *Field trials and phenotyping*

**Nelson Lubanga, Chris Davey** - *Genetic Markers and Genomic Selection*

**Paul Robson, Rebecca Wilson, David Treharne** - *Speed Breeding and phenotyping*

**Michal Mos (Energene Ltd.)** - *Southern latitude crossing*

**Judith Thornton, Danny Awty-Carroll, Iain Donnison** - *Project development*

**Gancho Slavov** - *Advisory*



Diolch / Thank You





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