Pre-breeding with synthetic wheat – stopping the gene pool from becoming stagnant!

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NIAB TAG Pre-breeding group
What is pre-breeding?

- Pre-breeding sits in the (big!) gap between “high science” and the market

- Moving new genes & traits into adapted backgrounds
- Much more likely to produce interesting parents than directly lead to new varieties
- It requires a different mindset - most of my NIAB selections would have got me the sack at Syngenta!
Synthetic Hexaploid Wheat (SHWs)

Modern Wheat

Aegilops speltoides (BB) × Triticum urartu (AA)

Wild Emmer
Triticum dicoccoides (AABB)

Wild Goat Grass
Aegilops tauschii (DD)

Chance hybridisation

Modern Wheat
Triticum aestivum (AA, BB, DD)
Synthetic Hexaploid Wheat (SHWs)

**Modern Wheat**
- Aegilops speltoides (BB)
- Triticum urartu (AA)
  - Wild Emmer
  - Triticum dicoccoides (AABB)
  - Wild Goat Grass
  - Aegilops tauschii (DD)
  - Chance hybridisation

**Synthetic Wheat**
- Durum Wheat
  - Triticum turgidum durum (AA, BB)
  - Unstable triploid F1 (ABD)
  - Chromosome doubling
- Wild Goat Grass
  - Aegilops tauschii (DD)

**Fully crossable – bringing DD variation into modern varieties**
Tetraploid / hexaploid direct crossing

Robigus, Paragon
*Triticum aestivum*

(AA, BB, DD)

×

Wild Emmer
*Triticum dicoccoides*

(AA, BB)

pentaploid F1

(AA, BB, D)

×

Robigus, Paragon
*Triticum dicoccoides*

(AA, BB)

Segregating BC1 generation

(AA, BB, D); (AA, BB, DD)

×

Robigus, Paragon
*Triticum dicoccoides*

(AA, BB)

Inbred BC1F5 generation

(AA, BB); (AA, BB, DD)

Cultivated Emmer
*Triticum dicoccum*

(AA, BB)

Durum Wheat
*Triticum durum*

(AA, BB)
Positive results so far......

- High yield potential in SHW-derived selections
  - Best yields >30% above adapted parent
- Room for further improvement:
  - eg 110% yield but 119% biomass: can we tweak harvest index further?
  - Even if yield only = best elites, likely to be for different reasons: are these additive?
- High yields may be maintained better at lower N than elites
- We have also seen increases in yield components:
  - Very large grains
  - Increased grain number
Cambridge-based scientists develop 'superwheat'

British scientists say they have developed a new type of wheat which could increase productivity by 30%.

The Cambridge-based National Institute of Agricultural Botany has combined an ancient ancestor of wheat with a modern variety to produce a new strain.

In early trials, the resulting crop seemed bigger and stronger than the current modern wheat varieties.

It will take at least five years of tests and regulatory approval before it is harvested by farmers.

Some farmers, however, are urging new initiatives between the food industry, scientists and government.

They believe the regulatory process needs to be speeded up to ensure that the global food security demands of the next few decades can be met, says the BBC's Tom Heap.

10,000-year-old wheat ancestor offers a grain of hope to farmers

The scientists transferred some of the resilience of the ancient ancestor of wheat into modern varieties.
NIAB’s pre-breeding is funded from several sources:
- BBSRC
- HGCA
- Breeders
- EU
- Technology Strategy Board
- NIAB Trust