The Future of Wheat and Bread?

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NIAB

• Founded 1919 – “Better Seeds, Better Crops”

• First 80 years: Variety Testing (NL/RL), Seed Certification, Seed Testing

• Privatisation (1996) → diversification away from statutory work, not-for-profit status

• Large investment into genetics & breeding research from 2005 onwards
  – Primarily wheat (and relatives) but also barley, oats, rice, oilseeds, pulses
Pre-breeding

- Crop ‘pre-breeding’ is one of the first stages in moving new genetic discoveries into elite commercial varieties.
- Pre-breeding does not deliver new varieties to growers, but the parents and grandparents of future varieties.
- Commercial breeders can integrate our most promising material into their programmes.
Possible sources of diversity

GM / genome editing

Land races etc

Mutants

Resynthesis

Related species
The origins of modern wheat

c. 100 000 BP

c. 10 000 BP

1. Diploid diversity
   *Ae. tauschii*

2. Tetraploid diversity
   *T. dicoccoides*
   *T. dicoccum*
   *T. durum*
Re-wilding wheat

Modern Wheat

Aegilops speltoides
(BB)

Triticum urartu
(AA)

X

Chance hybridisation

Wild Emmer
Triticum dicoccoides
(AABB)

X

Wild Goat Grass
Aegilops tauschii
(DD)

Chance hybridisation

Modern Wheat
Triticum aestivum
(AA, BB, DD)
Re-wilding wheat

Modern Wheat
- Aegilops speltoides (BB)
- Triticum urartu (AA)
- Triticum dicoccoides (AABB)

Wild Emmer
- Chance hybridisation

Wild Goat Grass
- Aegilops tauschii (DD)
- Chance hybridisation

Resynthesised Wheat
- Durum Wheat
  - Triticum turgidum durum (AA, BB)
  - Controlled hybridisation
  - Unstable triploid F1 (ABD)
  - Chromosome doubling

Stable Synthetic Hexaploid
- Triticum aestivum (AA, BB, DD)
Re-wilding wheat

Resynthesised Wheat

Durum Wheat
Triticum turgidum durum
(AA, BB)

Wild Goat Grass
Aegilops tauschii
(DD)

Controlled hybridisation

unstable triploid F1 (ABD)

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Re-wilding wheat

Fully crossable

Novel D-genome variation brought into bread wheat
Re-wilding wheat

- We are also exploring variation through crosses with other wheat relatives: durum, rivet, Khorasan, wild emmer, cultivated emmer
Why bother?

- To increase the genetic diversity of the UK wheat genepool
  - new sources of pest/disease resistance
  - new sources of stress tolerance
  - new ways of managing height / flowering time etc
  - improve flavour / nutritional profile
  - increase resource-use efficiency
  - preparation for challenges yet to be identified

- unexpectedly, new sources of yield improvement
A chance for a new, local approach?

• We have developed novel diversity, most of it is untested.
• Commercial breeders are already screening the best, but targeting their usual traits - largely agronomic.
• Why not screen for flavour and nutritional traits here before the usual yield/performance bottlenecks have constrained the diversity?
• Participatory selection with local growers and bakers?
• Currently considering how best to do this – ideas welcome!