Earliness & Resilience for Yield in a Changed Climate
ERYCC

Adapting wheat to global warming

HGCA Project 3214, 2007-2011
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Adapting wheat to global warming …

- **The Past:**
  Contribution of breeding to wheat yields
  .. from the 1950's
- **The Present:**
  Current physiological diversity
  in elite UK wheats
- **The Future:**
  Control of wheat phenology
  to facilitate further adaptation.

The ERYCC panel … 64 varieties

Historics (16)	*RL date*
Cappelle Desprez	1953
Maris Widgeon	1964
Huntsman	1972
Hobbit	1977
Hustler	1978
Virtue	1979
Avalon	1980
Longbow	1981
Norman	1981
Galahad	1983
Mercia	1984
Riband	1989
Haven	1990
Rialto	1993
Equinox	1995
Savannah	1996

Modern / Controls (26)	
Access	Malacca
Alchemy	Marksman
Ambrosia	Mascot
Battalion	Musket
Brompton	Oakley
Claire	Robigus
Consort	Rocky
Deben	Solstice
Dover	Xi19
Einstein	Zebedee
Gladiator	
Glasgow	
Gulliver	
Hereward	
Humber	
Istabraq	

Phenology (22)	
Alixan	Paragon
Andalou	Roysac
Apache	Sankara
Bacanora	Soissons
Buster	Spark
Cadenza	Timber
Caphorn	Velocity
Cezanne	
Cordiale	
Exotic	
Exsept	
Gatsby	
Hyperion	
Mendel	
Mercato	

Past contribution of breeding to UK wheat yields

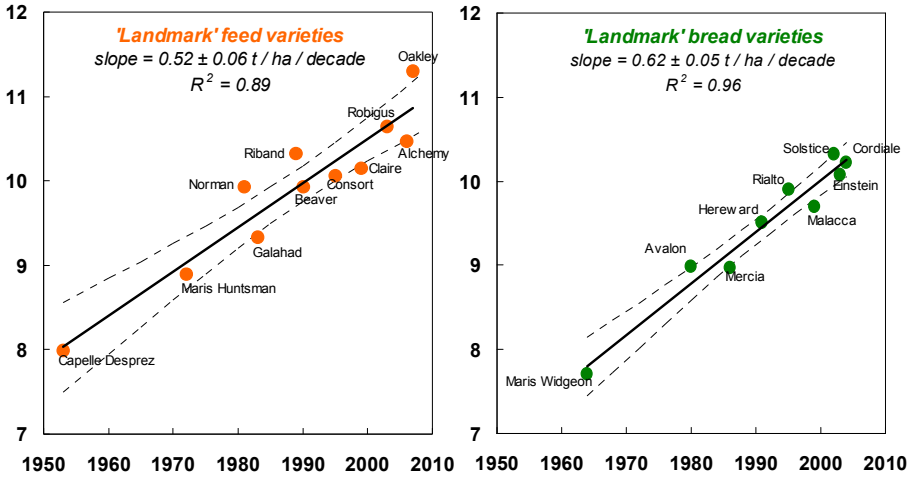
- **15 'RL type' trials with the ERYCC panel: 2007 – 2010**
  - Yorkshire, Norfolk, Suffolk, Cambs.
  - Phenology, growth & yield components

Data analysis:

- **Weighted mean yields for each variety**
  - data from all 15 experiments .. as in RL analysis
- **'Year of introduction' = NL1 + 3 years**
  - i.e. when it would have been added to RL
  - Trends expressed per decade of breeding
  - Widely used varieties = 'Landmark'

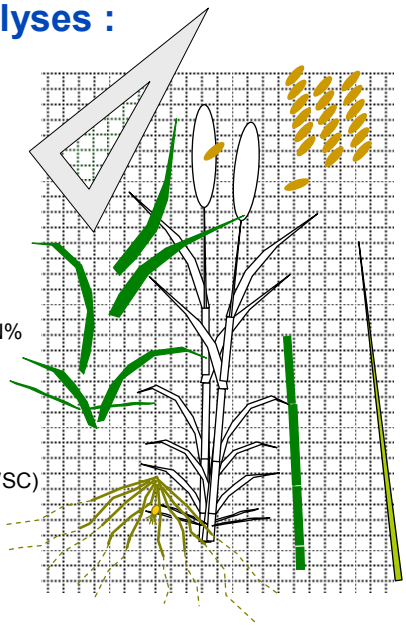
ERYCC yield trends, 2007-2010

Weighted means from 15 trials @ 85%DM (t/ha)



Yield determination – 4 analyses :

- **Harvest components**
  … Ears/m^2 x Grains/ear x TGW
- **Biomass x Harvest Index**
- **Nitrogen components**
  … N capture x N harvest index ÷ grain N%
- **Phases**
  – Construction
    … Duration x Rate x Redistribution (%WSC)
  – Production
    … Duration x Rate.

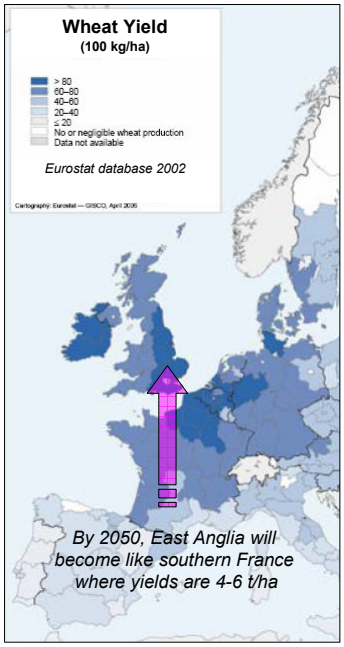


The Present

Physiological diversity in UK wheats

The future

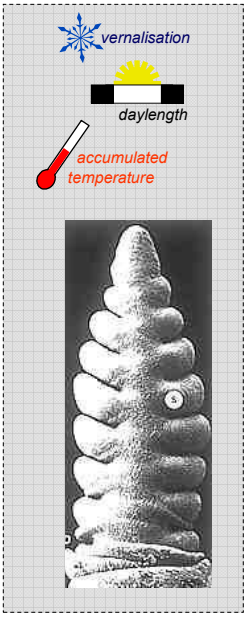
- **Climate**
  - Earlier
  - More frequently stressed
  - *BUT* .. day-lengths unchanged
- **ERYCC's hypothesis:**
  - Maintain 'Crop Construction'*?*
  - Earlier to GS31 *?*
  - Less photoperiod sensitivity *?*
- **ERYCC's aim:**
  - to improve variety calibrations for photoperiod sensitivity by modelling developmental dates.



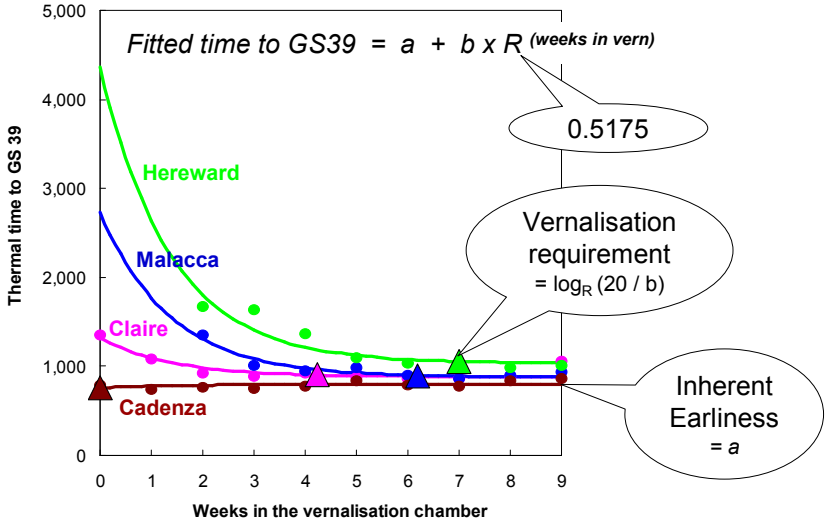
By 2050, East Anglia will become like southern France where yields are 4-6 t/ha

ERYCC modelling

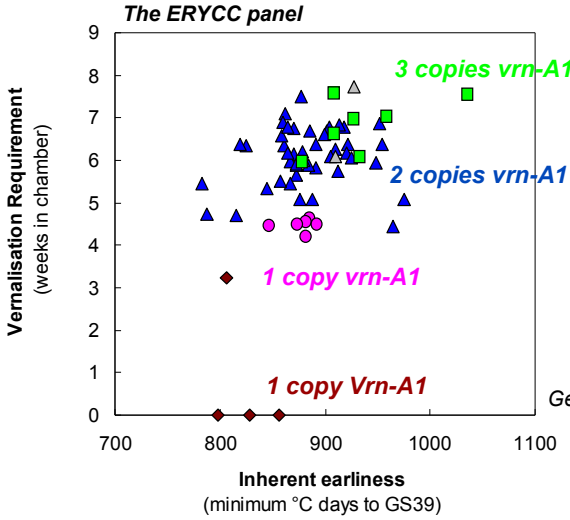
- **HGCA RL – plant development data**
  - Latest Safe Sowing Date
    - … spring sown field 'clumps' .. heading scores
  - Speed of development to GS31
    - … Plots in Yorks & Essex .. GS dates
- **ERYCC panel**
  - 9 field trials .. Yorks – Cambs
    - … Phyllochrons, Leaf counts & GS dates
  - 2 Photoperiod Extension trials .. Thriplow
- **Approaches to variety calibration**
  .. all unsuccessful
  - Sirius .. with Plant & Food Research, Lincoln NZ
  - Statistical fitting .. as Angus *et al.* (1981), Weir *et al.* (1984)
    - … Temperature .. inherent earliness
    - … Vernalisation responsiveness
    - … Photoperiod responsiveness.



Vernalisation experiment



Vernalisation requirement & Inherent earliness



Genotyping by D Laurie et al. (JIC)

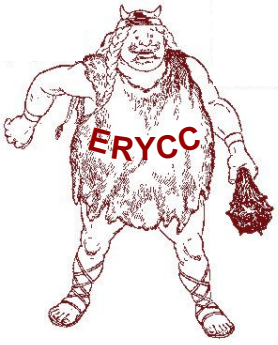
Further work:

- Assess Vern. Reqts. in 'vernal time'
- Apply Vern. Reqts. to field data.

ERYCC's achievements

- **Genetic yield improvement *is*:**
  - 0.5 – 0.6 tonnes / ha / decade
- **UK wheat is physiologically diverse**
  - Known sources for trait-based yield-breeding
- **Vernalisation requirements explained**
  - But photoperiod responses .. not yet
- **'The ERYCC panel' of 64 varieties**
  - now facilitating analysis of UK wheat
- **Three DH populations for yield analysis**
  - **Oakley** x Battallion, Gatsby, Exsept
  - ~350 lines.

Thank you



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