

“Tools, resources, genotyping and phenotyping”

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Thank you to:

- **Simon Orford, Alba Farre, Ji Zhou, Rajani Awal, Cathy Mumford and the Field Trials Team**
- **Current and former group members previously involved**
- **DEFRA**

WGIN Projects Overview

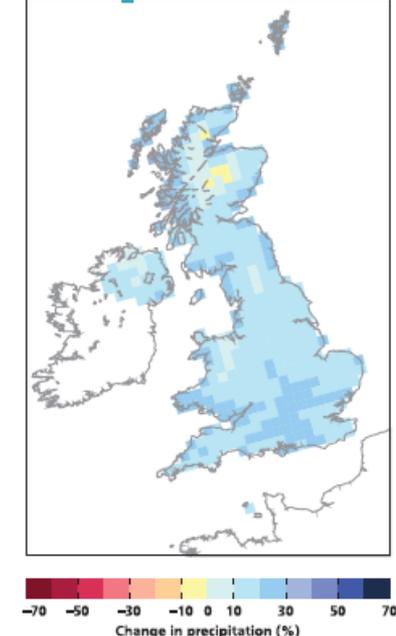
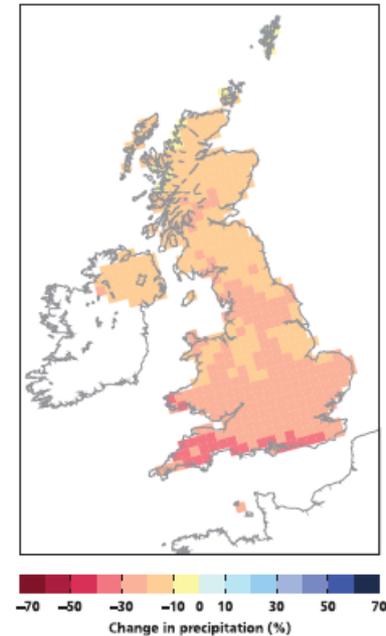
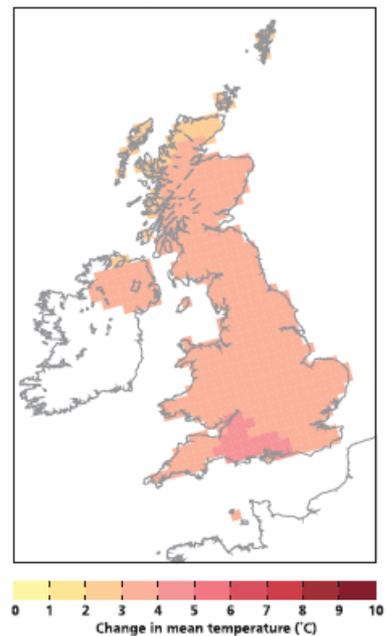
- Crossing different combinations of genes / QTLs / mutations into a common background (**Paragon**) and studying the phenotypic effects
- Known as the **Paragon Library**
- Looking at interactions between genes x environment in **Avalon x Cadenza** NILs
- Generating **new populations** (RL crosses, Chromosome Segment Substitution Libraries and Breeding-by-Design)
- Dissecting UK drought tolerance in **Paragon** x **Garcia**

UK Drought

DEFRA “Adapting to climate change: UK Climate Projections” 2011

- UK will get warmer, more in summer than winter ↑
- Summer precipitation tends to decrease ↓
- Winter precipitation tends to increase. ↑

Predictions
for 2080's



UK Drought

Met Office “Climate: Observations, Projections and Impacts” 2011

- Vulnerability to water stress is currently focussed in the south and south-east of the UK.
- These regions are projected to experience an increase in the frequency of droughts and water stress with climate change.



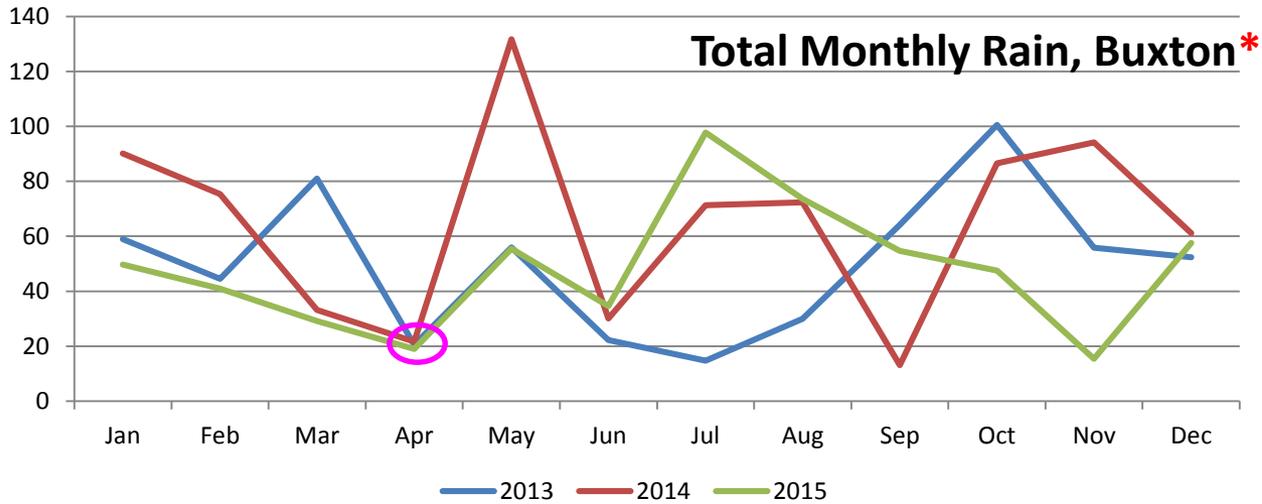
UK drought

- These are *predictions* but must explore mechanisms to cope with these scenarios, to breed resilience to climate change
- The **Paragon** x **Garcia** population was generated within WGIN to study **drought tolerance**
- Defra LINK Project: **LK0986**: *Improving water use efficiency and drought tolerance in UK winter wheats* (Eric Ober and colleagues)

UK drought

- LINK project evaluated 120 lines under irrigated and managed drought
- DT index (DTI), water use efficiency (WUE), yield potential and yield stability.
- Results showed that significant genotypic diversity for drought tolerance and WUE
- Wheat yields in the UK are often limited by water deficit during critical early stages of crop development
- Elsewhere in the world drought affects grain filling

UK drought



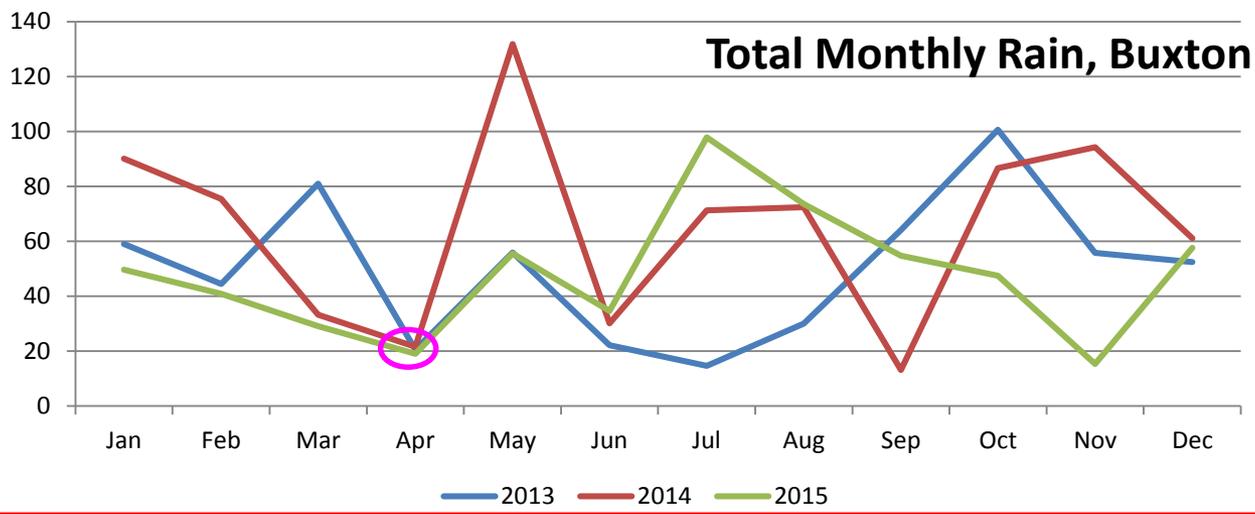
Grain number is determined



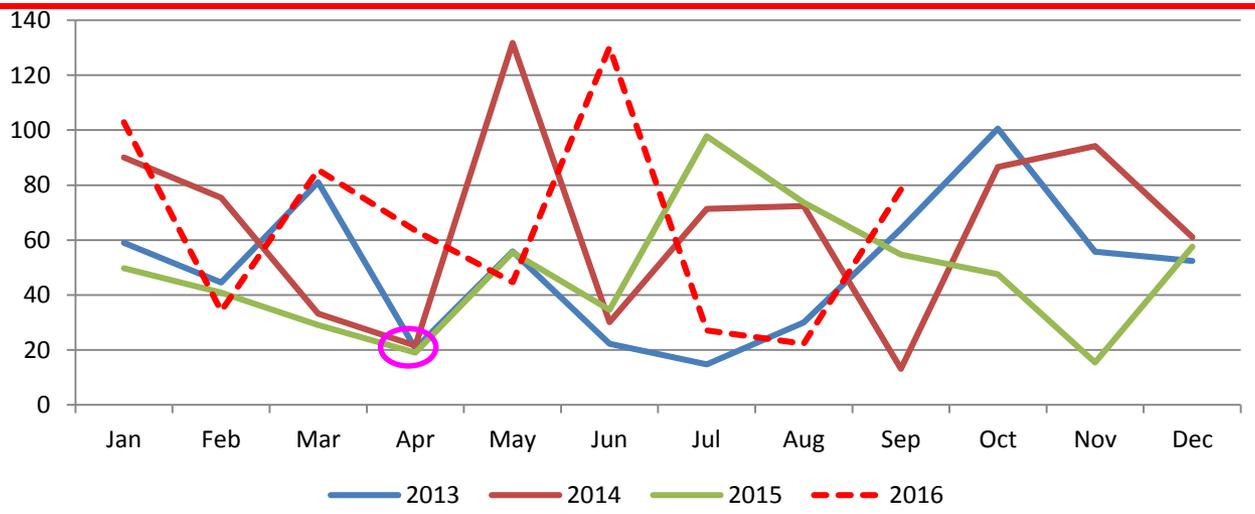
Files from the J Centre

Weather data courtesy of <http://>

UK drought



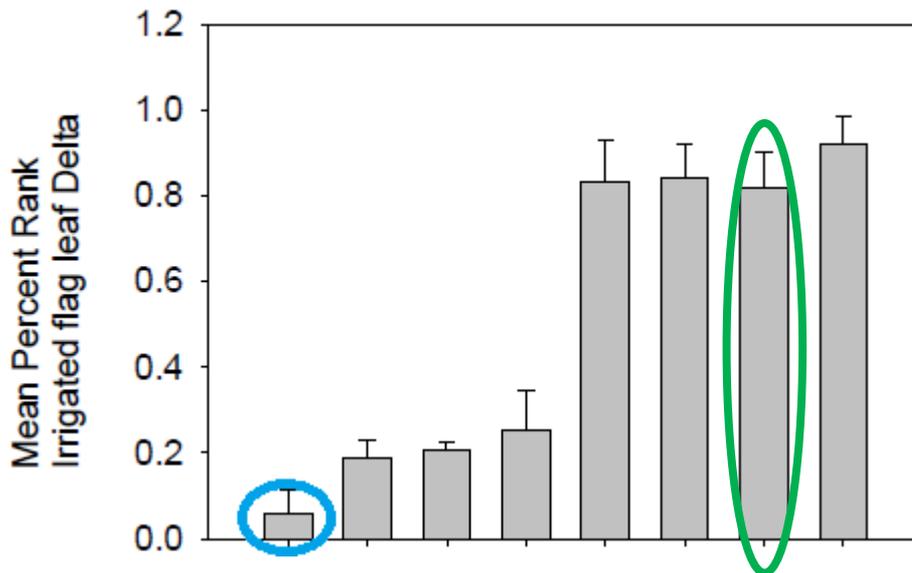
Unfortunately one doesn't always get drought when you want it...!



UK drought tolerance

- LINK project indicated that the carbon isotope discrimination ratio (Delta) has a negative correlation with Drought Tolerance
- Four varieties showed consistently low values for carbon isotope discrimination ratio, which included **Garcia**. **Paragon** had a consistently high ratio

- The **Pal** genera



originally

UK Drought Tolerance in Paragon x Garcia

- Paragon x Garcia (PxG) RIL population produced within WGIN to specifically target UK drought (~350 lines)
- **Paragon** - UK spring wheat
- **Garcia** - grown in southern France and northern Spain
- adapted to drought stress



UK Drought Tolerance in Paragon x Garcia

- Potentially advantageous to look for drought-tolerant characteristics in non-UK wheat varieties such as Garcia
- Genetic maps of Paragon x Garcia population available
- Genetic + phenotypic data should allow identification of regions of chromosome carrying drought tolerant genes
- NILs can be generated carrying these regions and used to validate the phenotypic effect.
- If successful could be introduced into breeding programmes to improve drought tolerance in UK wheat

UK Drought Tolerance in Paragon x Garcia

- Drought Trial with selected PxG RILs (*Ppd*-sensitive)
- Included subset of **Paragon Library** (9 lines)
- 2 reps each of **Irrigated** / **Not Irrigated** plots

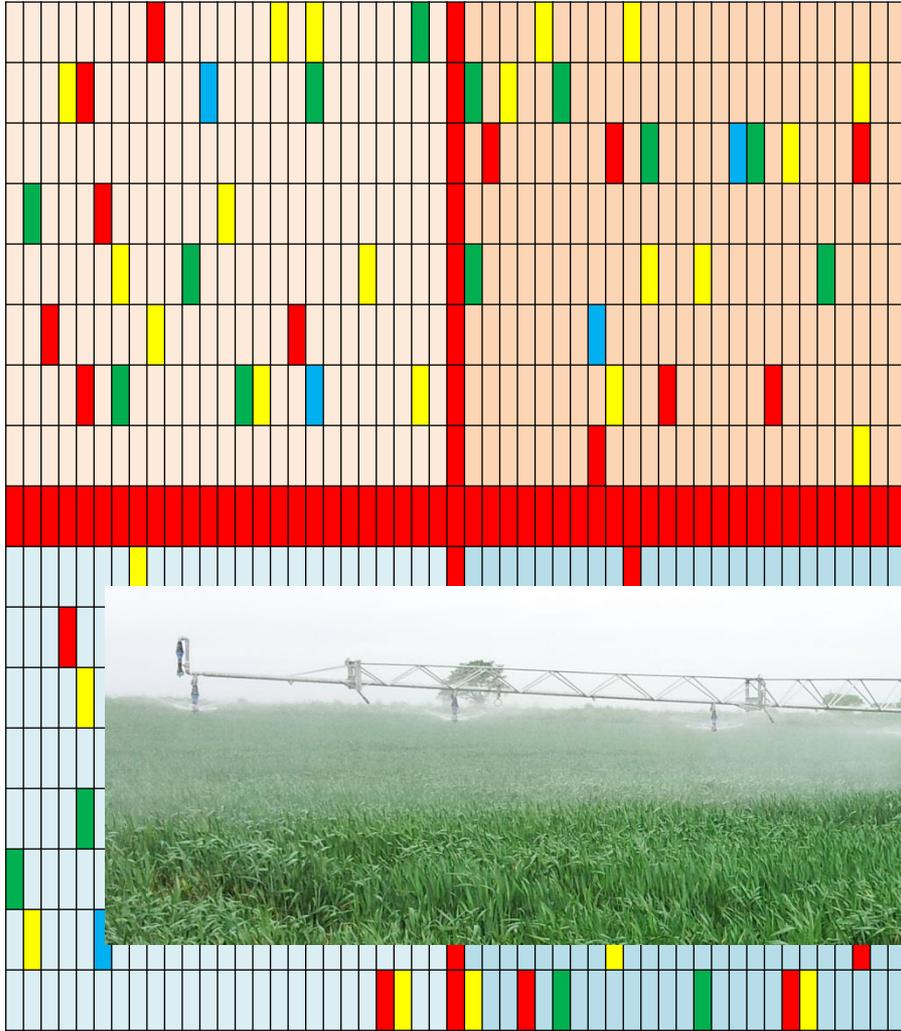
- **Traits recorded/measured:**

Dates of Stage 31, Booting and Ear Emergence, plus Height, Yield, Specific Weight, TGWT, (Lodging and Senescence)



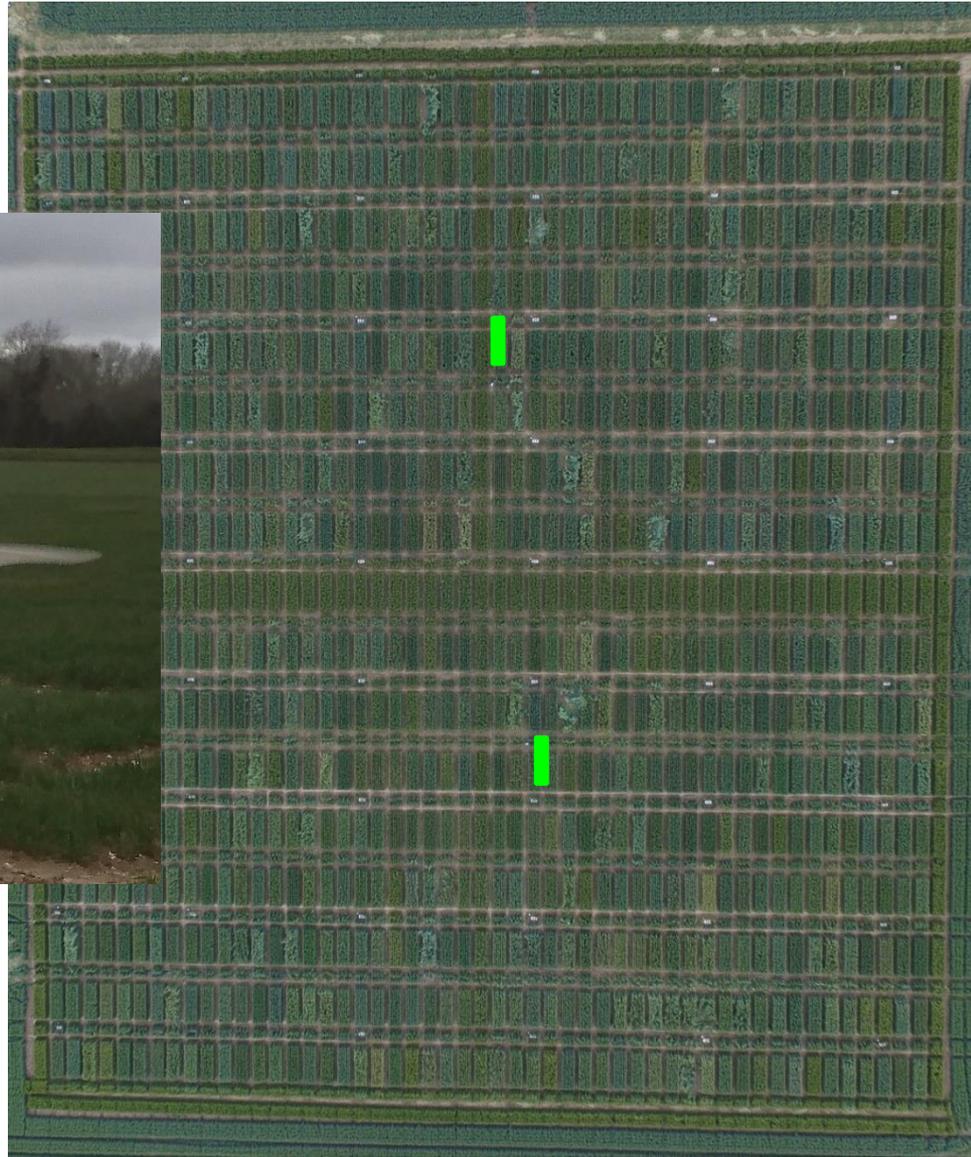
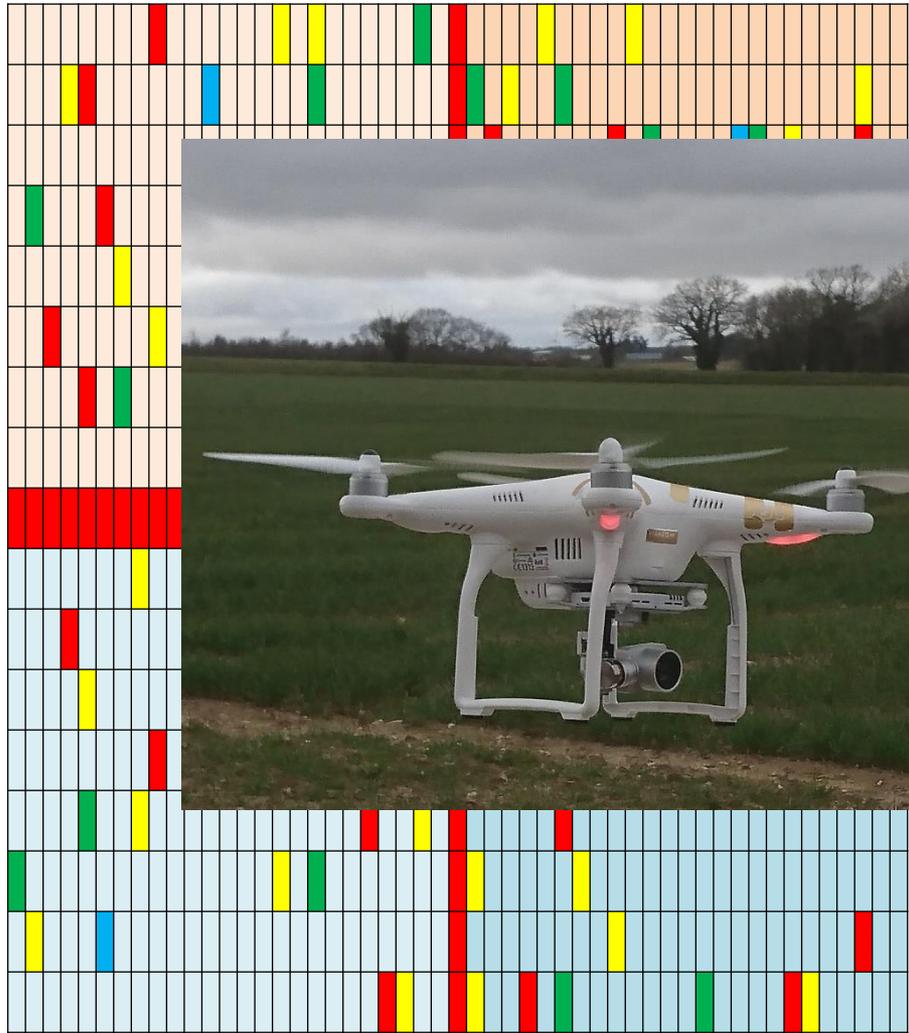
UK Drought Tolerance in Paragon x Garcia

Trial Layout



Irrigation of lower plots

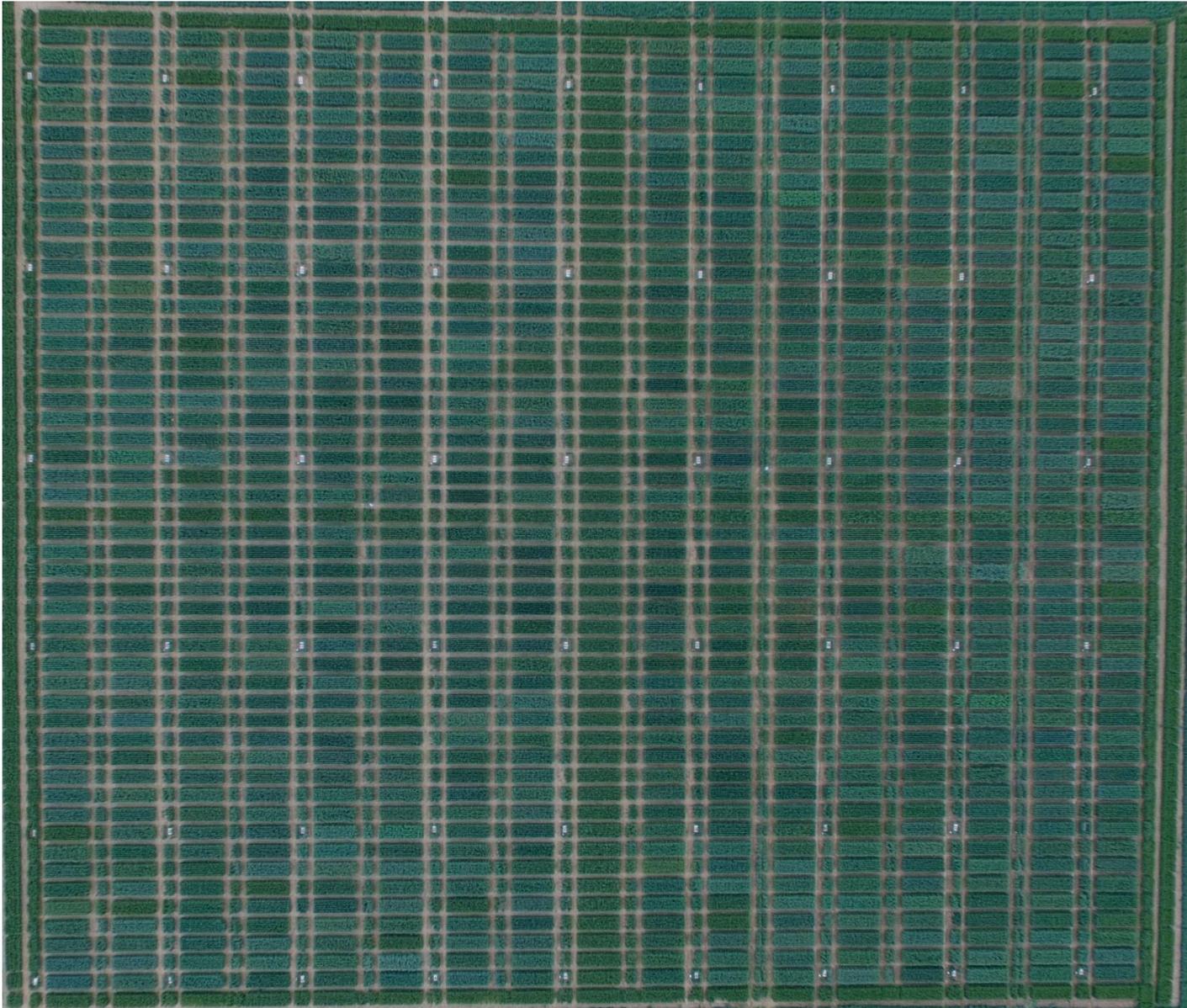
UK Drought Tolerance in Paragon x Garcia



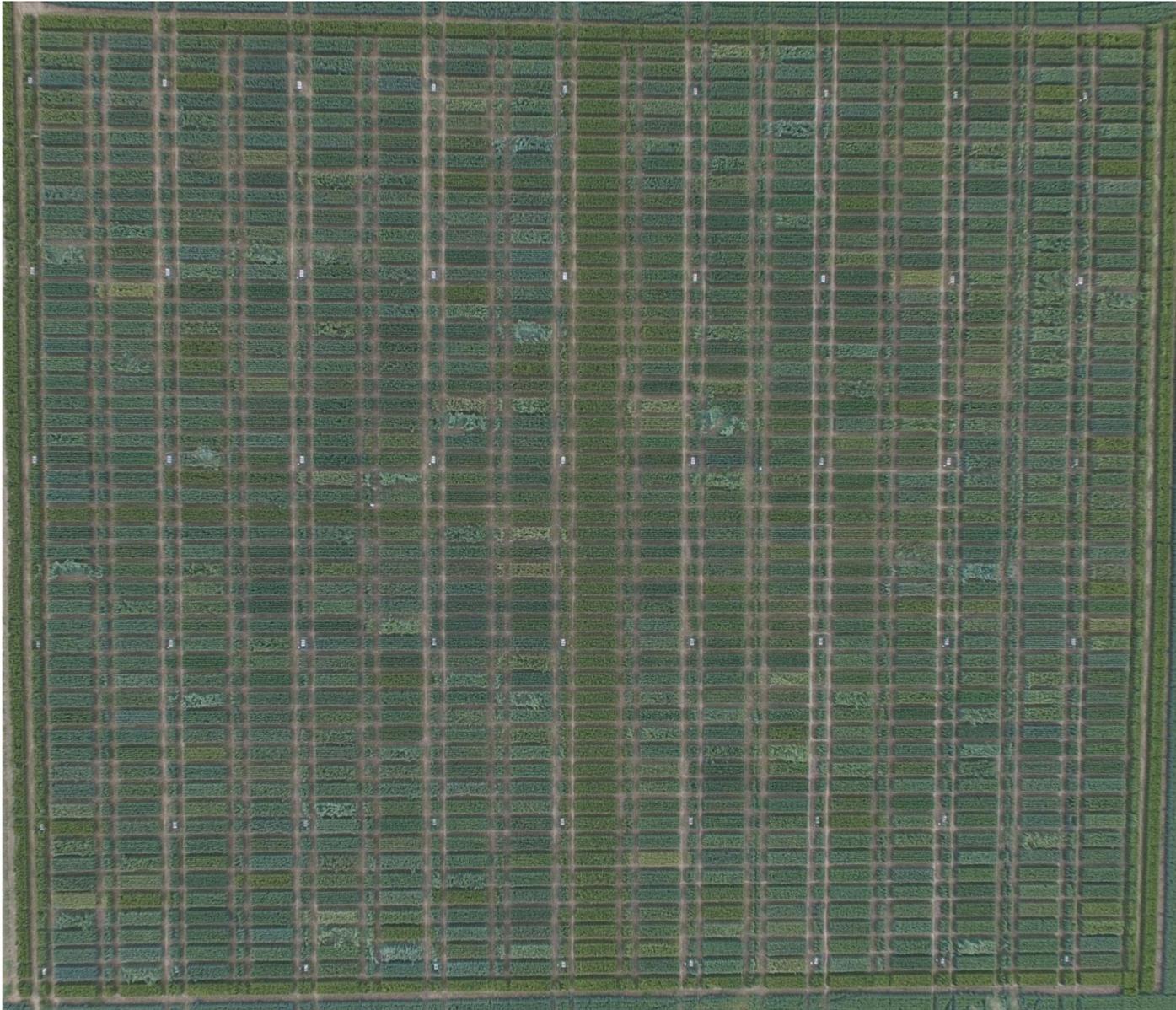
Soil water content and temperature monitoring

Aerial monitoring with UAV

UK Drought Tolerance in Paragon x Garcia



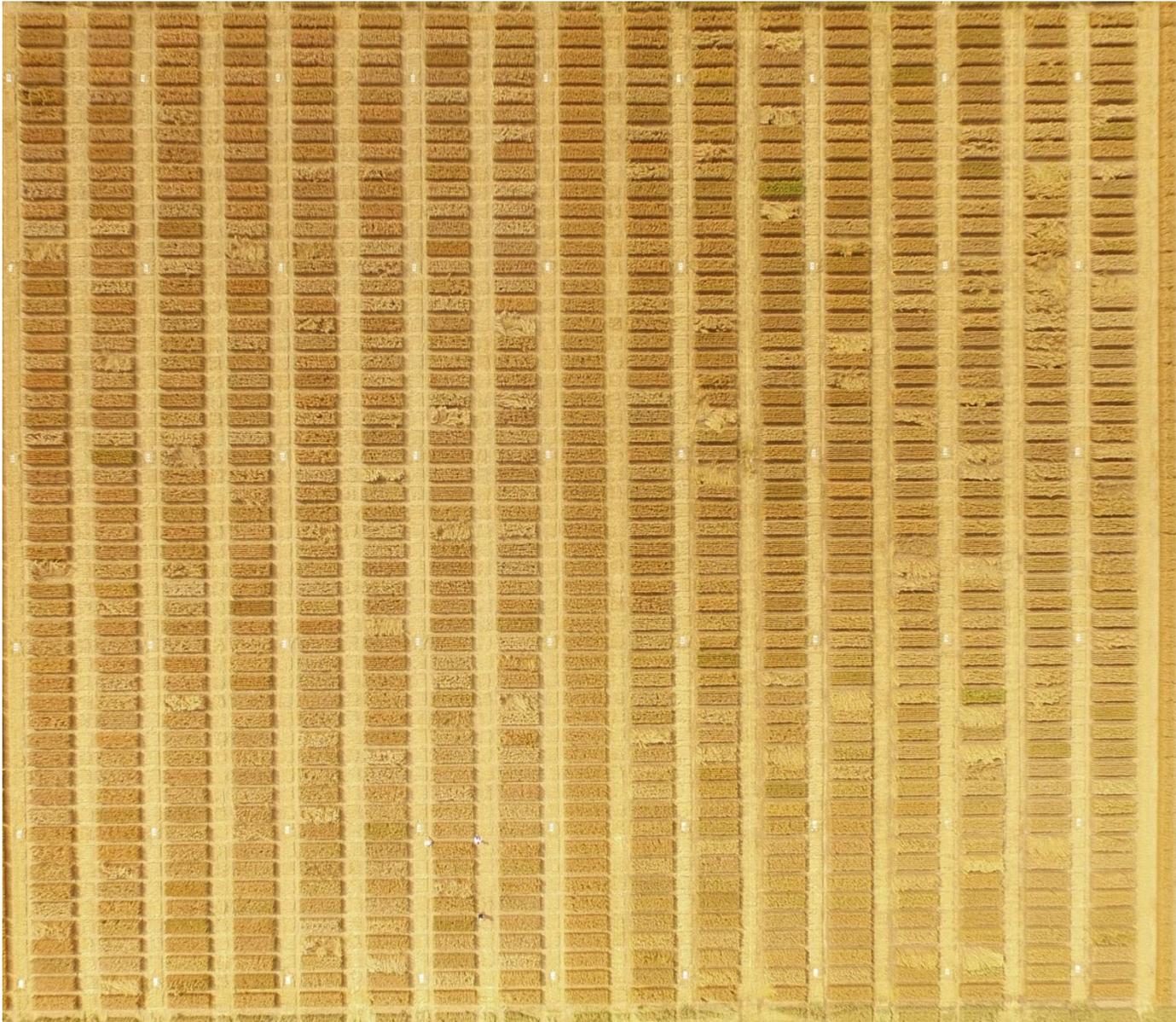
UK Drought Tolerance in Paragon x Garcia



UK Drought Tolerance in Paragon x Garcia

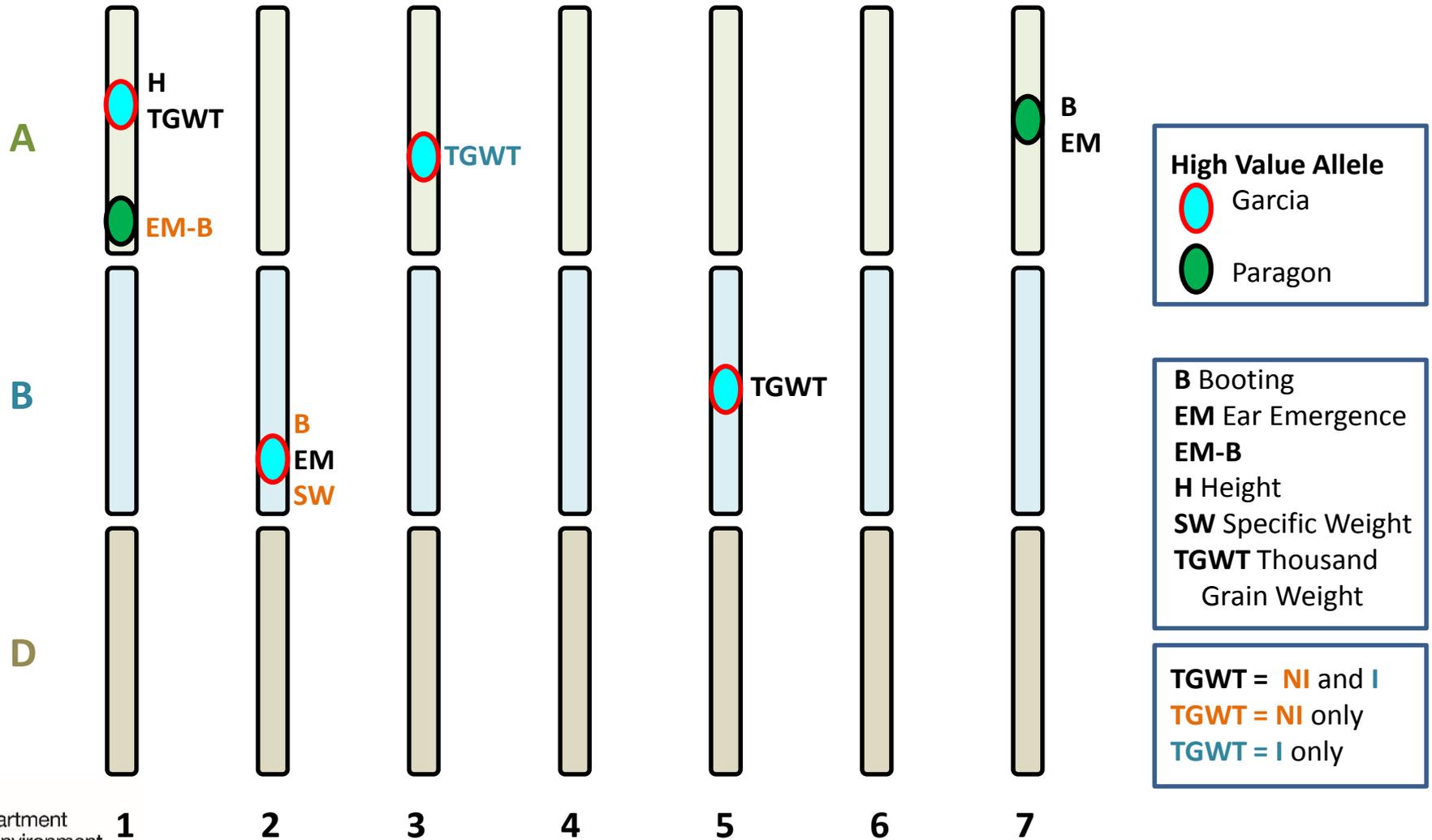


UK Drought Tolerance in Paragon x Garcia



UK Drought Tolerance in Paragon x Garcia

Computational analysis of Genotypic + Phenotypic data: Chromosomal regions identified



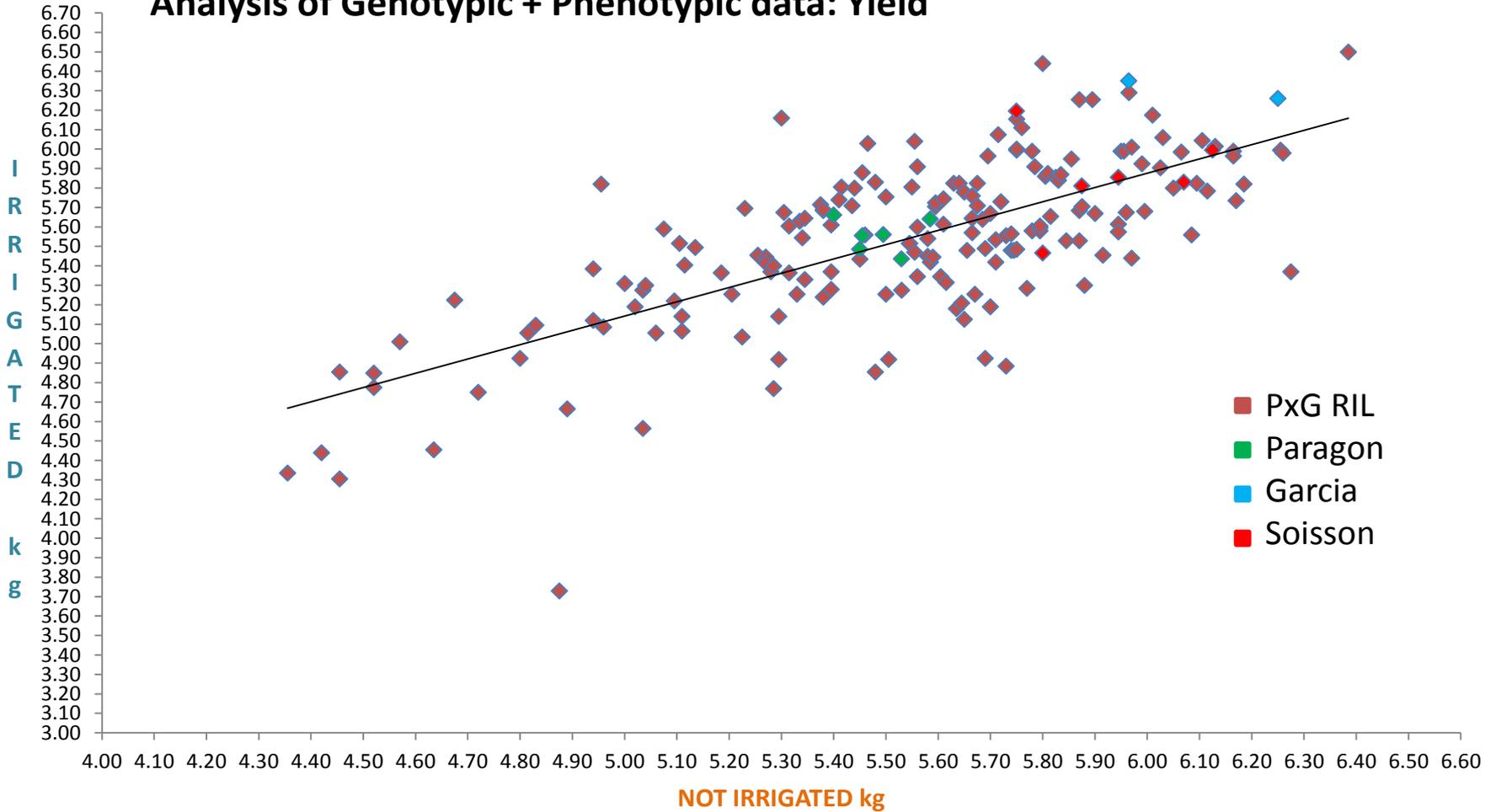
High Value Allele
 Garcia
 Paragon

B Booting
 EM Ear Emergence
 EM-B
 H Height
 SW Specific Weight
 TGWT Thousand Grain Weight

TGWT = NI and I
 TGWT = NI only
 TGWT = I only

UK Drought Tolerance in Paragon x Garcia

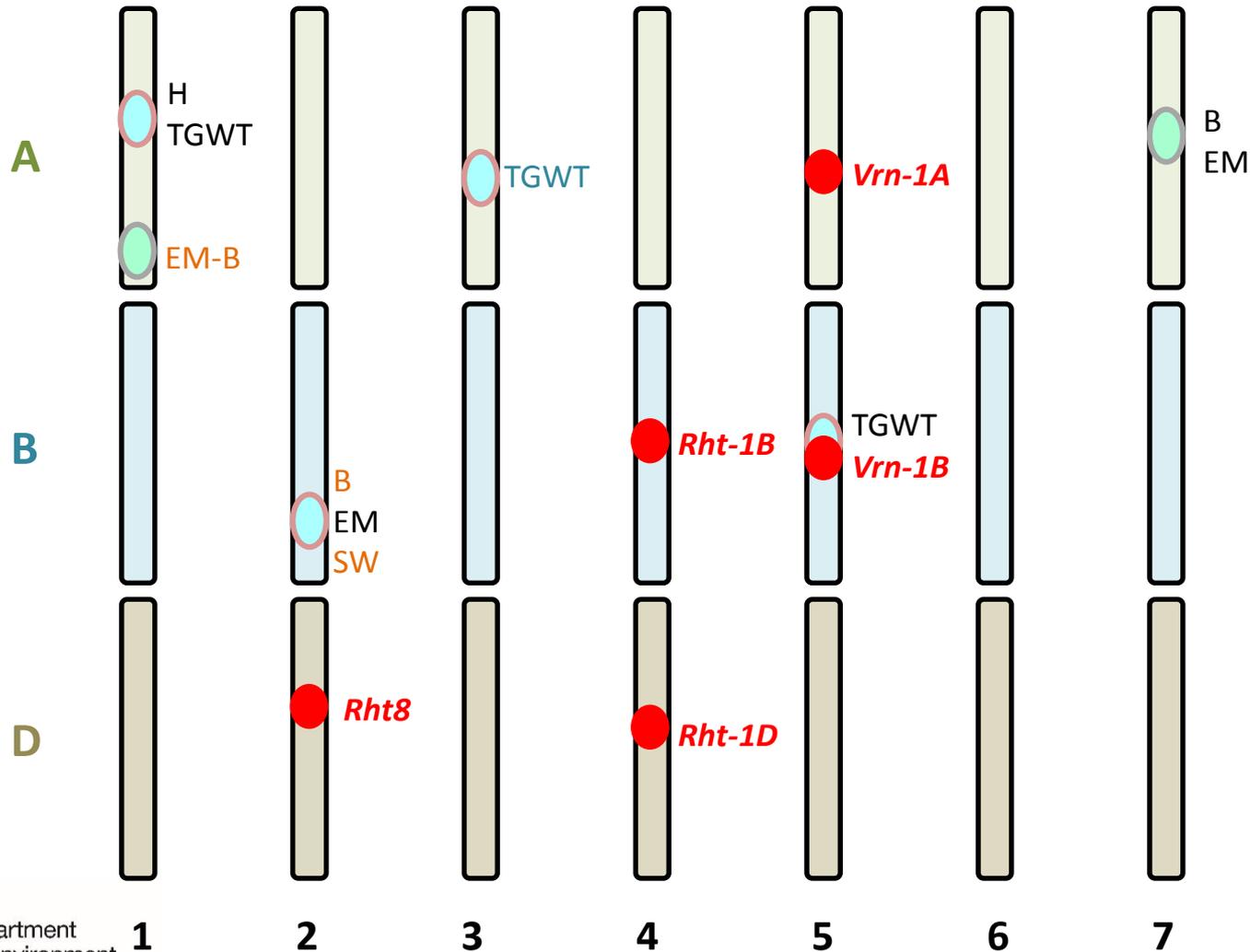
Analysis of Genotypic + Phenotypic data: Yield



Irrigated = 4.4 kg / Not Irrigated = 4.0 kg

UK Drought Tolerance in Paragon x Garcia

New combinations of **genes** in the **Paragon Library**: i.e. Rht's and Vrn



UK Drought Tolerance in Paragon x Garcia

- Drought Trial being repeated 2016-2017
- Location: Riverside Field, Church Farm, Bawburgh
- Field with lighter sandy soil and gentler slope
- **WHAT I NEED NOW IS A DROUGHT!**
- but maybe just over *my* field you're probably thinking!

