Genomics and drought tolerance in wheat

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Genomics-Assisted Breeding Workshop

What is drought?
- No water – death
- Some crops face critical thresholds

Wheat
- Linear response to drought
- Dealing with environmental variability rather than drought per se

Global wheat production (2011)

<table>
<thead>
<tr>
<th>Production (million t)</th>
<th>Area (million ha)</th>
<th>Yield (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>651</td>
<td>217</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Factors limiting productivity in low yielding environments

Drought tolerance?
The art of compromise
- Access to water – roots
- Efficiency of water and resource use
- Access to CO₂ versus limiting water loss
- Roots versus shoots,
- Storage versus growth
- Protection from damage (especially reproductive)

Physiological breeding
- Association of yield performance (g/m²) and canopy temperature (°C) under drought stress,
  Seri/Babax population in NW Mexico (cycle 2001/2002) (from Olivares et al., 2007).

Mexico Irrigated
Mexico Drought
Booleroo
Phenotypic screening
- Fixed environment
- Detailed environment monitoring
- Precision Phenotyping
- Statistical analysis
  - Prediction of performance
  - Spatial analysis
  - Fixed genetic effects

Genetic engineering

Yield under drought and heat stress

Julien Bonneau et al., TAG 2012
Conclusions

- Drought
  - Tolerance to abnormal conditions
  - Yield stability
  - Modern varieties are well adapted to their target environments
- Options
  - Drought is complex so target simple traits
  - Deficit elimination
  - Salinity, boron, nematodes, etc
  - Physiological breeding
  - Importance of phenotype
    - Improved analysis of phenotypic data
    - Improved phenotyping techniques
  - Key alleles may be environment specific
  - Define genotype x environment relationships

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