Public sector breeding to prepare for changing climates

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Public Sector Breeding to Prepare for Changing Climates

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Wheat Breeding Priorities
(MN Spring Wheat)

**Agronomic Characteristics**
1. Yield
2. Lodging resistance
3. Test Weight
4. Shattering
5. Kernel color
6. Pre-harvest sprouting resistance

**Diseases**
1. Fusarium head blight (scab)
2. Leaf rust
3. Bacterial leaf streak
4. Stripe rust
5. Leaf Spotting (Tan Spot, Septoria's)
6. Barley yellow dwarf virus
7. Stem rust

**Bread-Making Quality Characteristics**
1. % protein
2. Mixing Properties
3. Loaf Volume
4. Flour Water Absorption
5. Kernel Hardness
6. Flour color
7. Milling Yield
8. Percent Flour Ash
Improving barley and wheat germplasm for changing environments

Triticeae CAP (T-CAP)
56 participants, 28 institutions, 21 states

Project Directors:
Jorge Dubcovsky
Gary Muehlbauer
Integration of wheat and barley research communities

The T-CAP includes:
• 56 participants
• 28 institutions
• 21 states.
Most have previous experience in the BarleyCAP and WheatCAP projects

Project-wide resources and activities
- Genotyping labs, SNP development, KS also GBS
- National Small Grain Collection
- Database, web resources & tools
- Project direction
- Education coordination
- Industry liaison coordination

States with former BarleyCAP and WheatCAP programs
States with WheatCAP programs
States with BarleyCAP programs

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Traits

• **Disease resistance**
  – Barley and wheat stem, stripe and leaf rust
  – Barley spot blotch & spot-form net blotch

• **Water and Nitrogen use efficiency, yield**
  – Regular agronomic traits
  – Protein (and minerals)
  – Canopy spectral reflectance (heading + grain filling)
    - WUE productivity under water stress / non-stressed conditions.
      - NWI-1 \((R_{970-900})/(R_{970+R900})\), NWI-3 \((R_{970-R850})/(R_{970+R850})\)
      - CID (carbon isotope discrimination)
    - Biomass: NDVI \((R_{900-R680})/(R_{900+R680})\)
    - NUE productivity under N limiting/ non-stressed conditions
      - Protein content
      - Sdr/Sdv (need 680/760 and 490/530) complex formula
        - \(GPC-B1\)

• **LTT** (barley only)
Populations to Discover New Genes

<table>
<thead>
<tr>
<th>WHEAT AM POPULATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spring wheat</strong>: 300 lines for drought tolerance <em>(10% in common with CIMMYT AM and 10% Canada AM)</em>.</td>
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<tr>
<td><strong>Wheat diseases</strong>: 384 lines for leaf rust and 384 lines for stripe rust.</td>
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<td><strong>Hard winter wheat</strong>: 300 hard wheat lines. NUE, WUE and yield.</td>
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<tr>
<td><strong>Soft winter wheat</strong>: 300 soft wheat lines. NUE and yield</td>
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</tbody>
</table>
Testing Locations

- Roseau
- Crookston
- Morris
- Lamberton
- Waseca
- St. Paul
- On-Farm
- U of MN Land
- NDSU trials
Fusarium head blight (scab)

- Frequent epidemics in U.S. since 1993
  - Wetter conditions at flowering time
  - Cultural practices that result in more residue on soil surface
Bacterial Leaf Streak (BLS)  
(*Xanthomonas translucens*)

- Increased incidence since 2005. Why?
- No control options, some varietal differences

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Yield vs. Protein – Northern MN 2012-2014

The graph shows a scatter plot with grain yield (%) of mean on the x-axis and grain protein (%) on the y-axis. Each point represents a different variety, with labels such as Glenn, Barlow, Forefront, and Vantage. The line indicates the trend between yield and protein content across the varieties.
Yield Stability – Northern MN 2012 -2014

Average Rank

Rank Variance

Advance
Albany
Barlow
Breakaway
Breaker
Faller
Forefront
Glenn
Jenna
Knudson
Linkert
Marshall
Norden
Powerplay
Prosper
RB07
Rollag
Samson
SY Soren
Vantage
WB-Monville
WB-Mayville
Vantage
WB-Digger
WB-Mayville
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Funding

• Federal
  — U.S. Wheat & Barley Scab Initiative
  — USDA-NIFA T-CAP (Leaf and stem rust)

• University of Minnesota
  — Minnesota Agricultural Experiment Station
  — MN Small Grains Initiative
  — Variety Development Fund

• NGOs
  — Minnesota Wheat Research & Promotion Council
  — Gates Foundation (Durable rust resistance)
Wheat Breeding Research Team

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Thank you!

United States Department of Agriculture
National Institute of Food and Agriculture

Pacific Northwest Farmers Cooperative

Monsanto