Transitioning Cereal Systems to Adapt to Climate Change

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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

BARLEY CAP

WHEAT CAP
Coordinated Agricultural Project

Triticeae CAP (T-CAP)

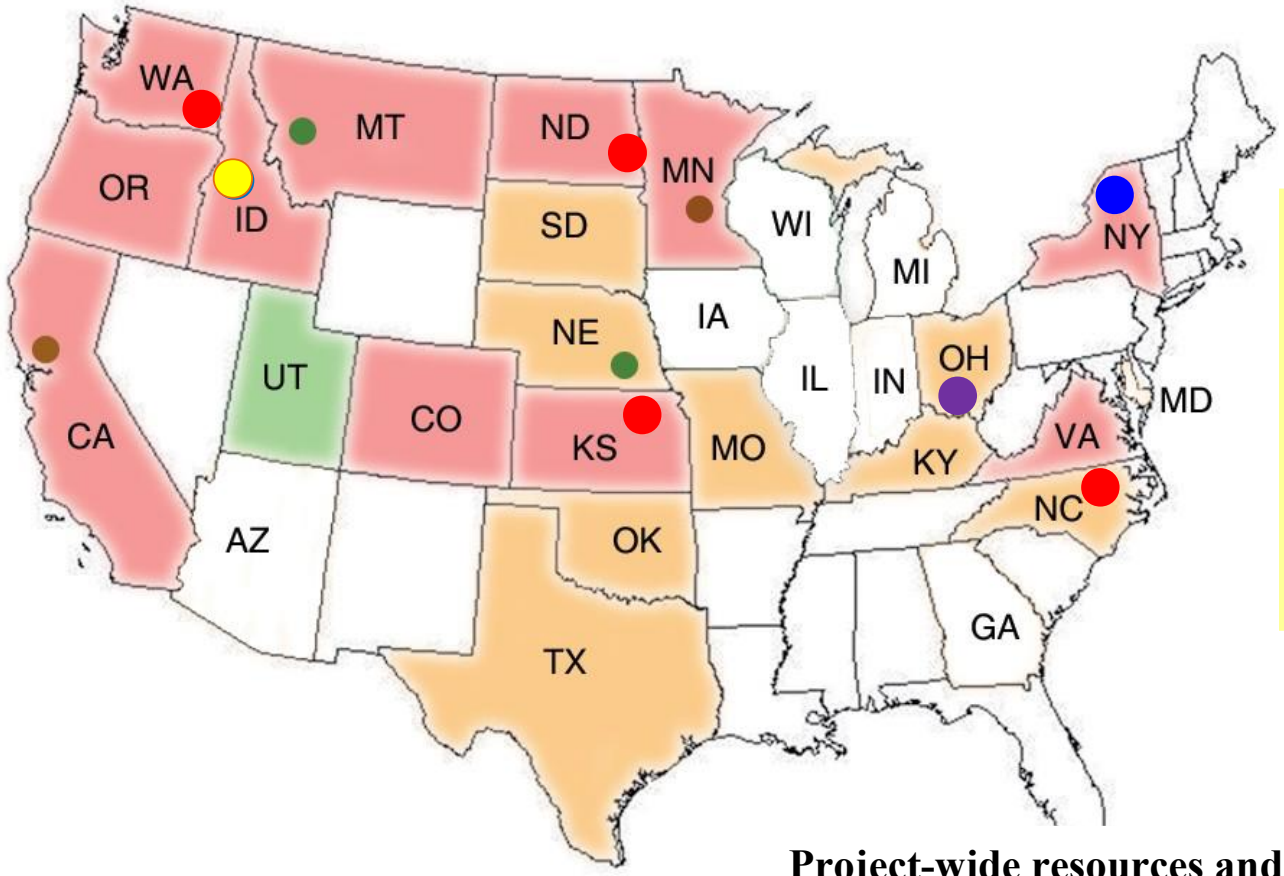
56 participants, 28 institutions, 21 states

USDA United States Department of Agriculture National Institute of Food and Agriculture

AWARD NUMBER: 2011-68002-30029

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

States with former BarleyCAP and WheatCAP programs

States with WheatCAP programs

States with BarleyCAP programs

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

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 (R970–R900)/(R970+R900), NWI-3 (R970–R850)/(R970+R850)
      - CID (carbon isotope discrimination)
    - **Biomass**: NDVI (R900–R680)/(R900+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

WHEAT AM POPULATIONS

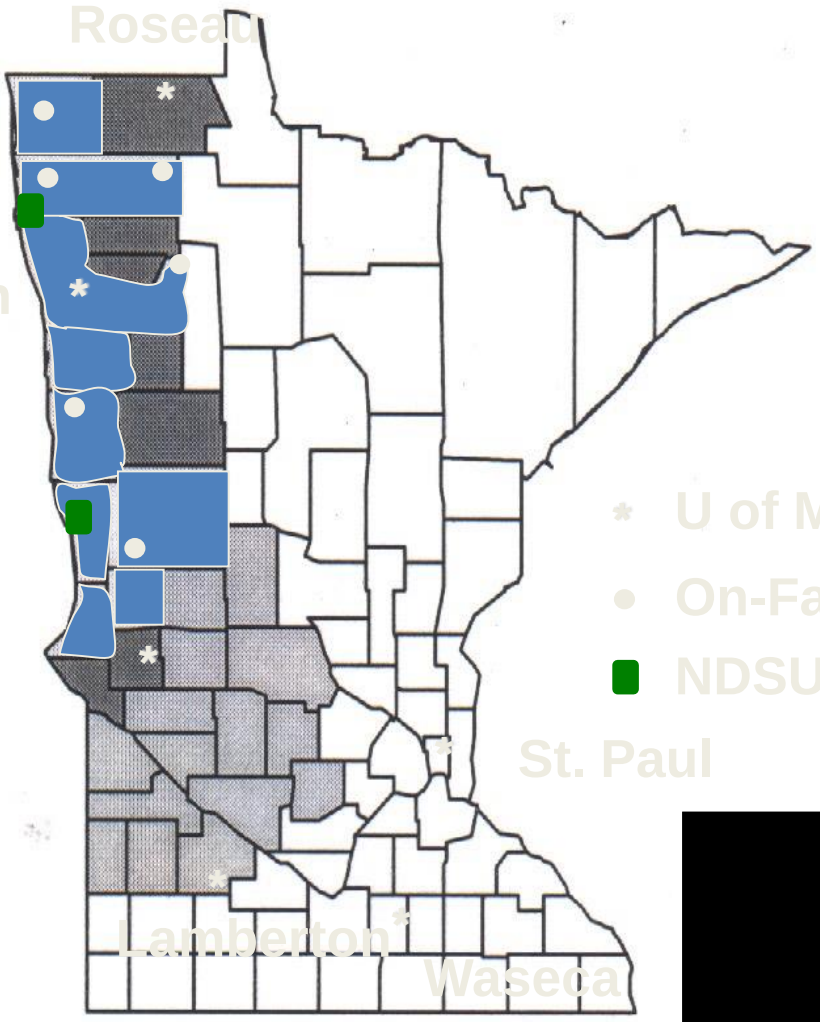
Spring wheat: 300 lines for drought tolerance (10% in common with CIMMYT AM and 10% Canada AM).

Wheat diseases: 384 lines for leaf rust and 384 lines for stripe rust.

Hard winter wheat: 300 hard wheat lines. NUE, WUE and yield.

Soft winter wheat: 300 soft wheat lines. NUE and yield

Testing Locations



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

Entry	Scab
Forefront	3
Rollag	3
Glenn	3
Breaker	4
SY Soren	4
Barlow	4
Faller	4
LCS Albany	4
RB07	4
Breakaway	5
Elgin-ND	5
Norden	5
Linkert	5
Prosper	5
Powerplay	5
Vantage	5
Knudson	6
WB-Digger	7
Jenna	7
WB-Mayville	7
Marshall	7
Samson	8
Prevail	-
SY Rowyn	–
SY Ingmar	–
Advance	–
LCS Iguacu	–
HRS 3361	–
HRS 3419	–
HRS 3378	–
WB9507	–

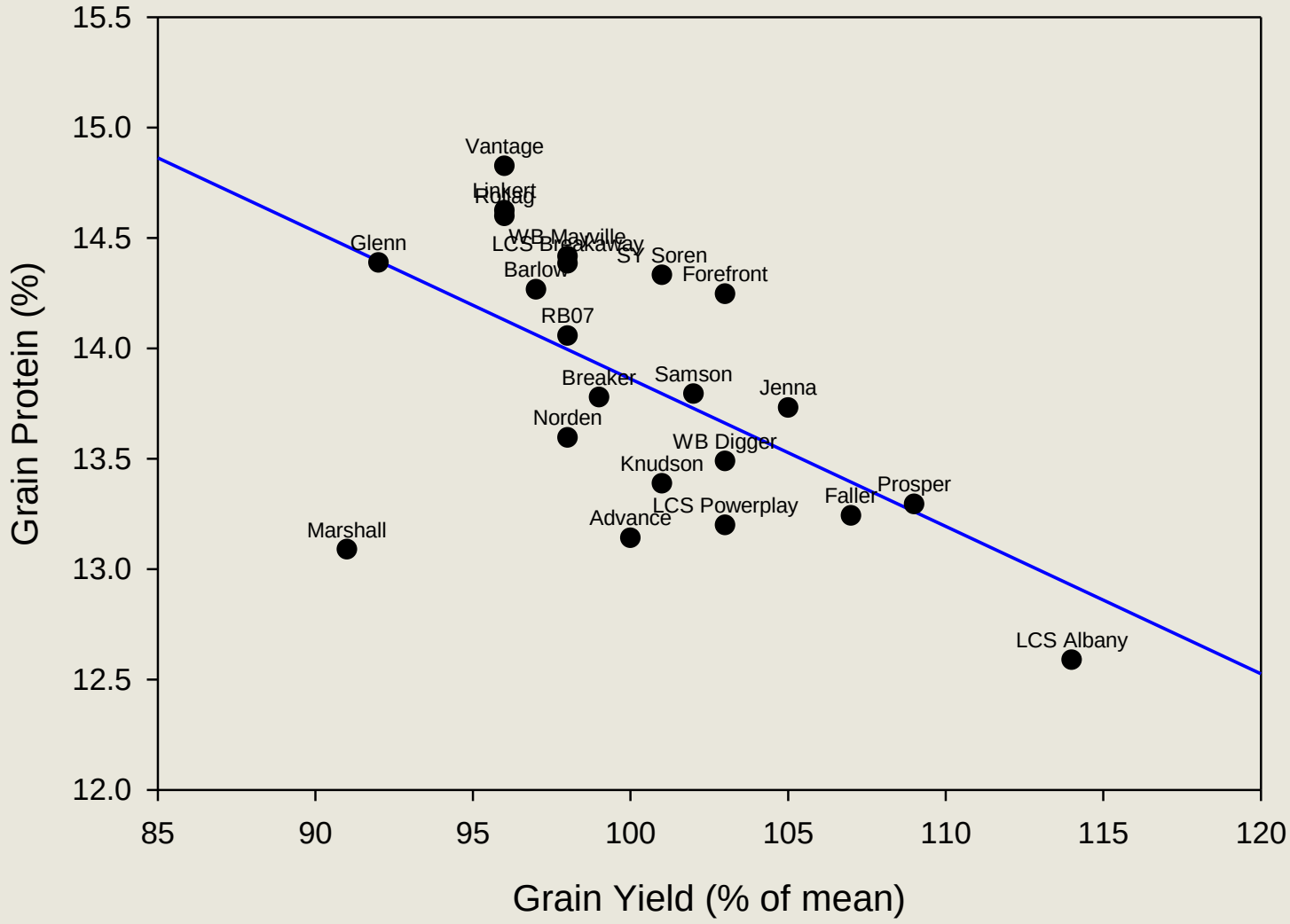
Bacterial Leaf Streak (BLS)

(*Xanthomonas translucens*)

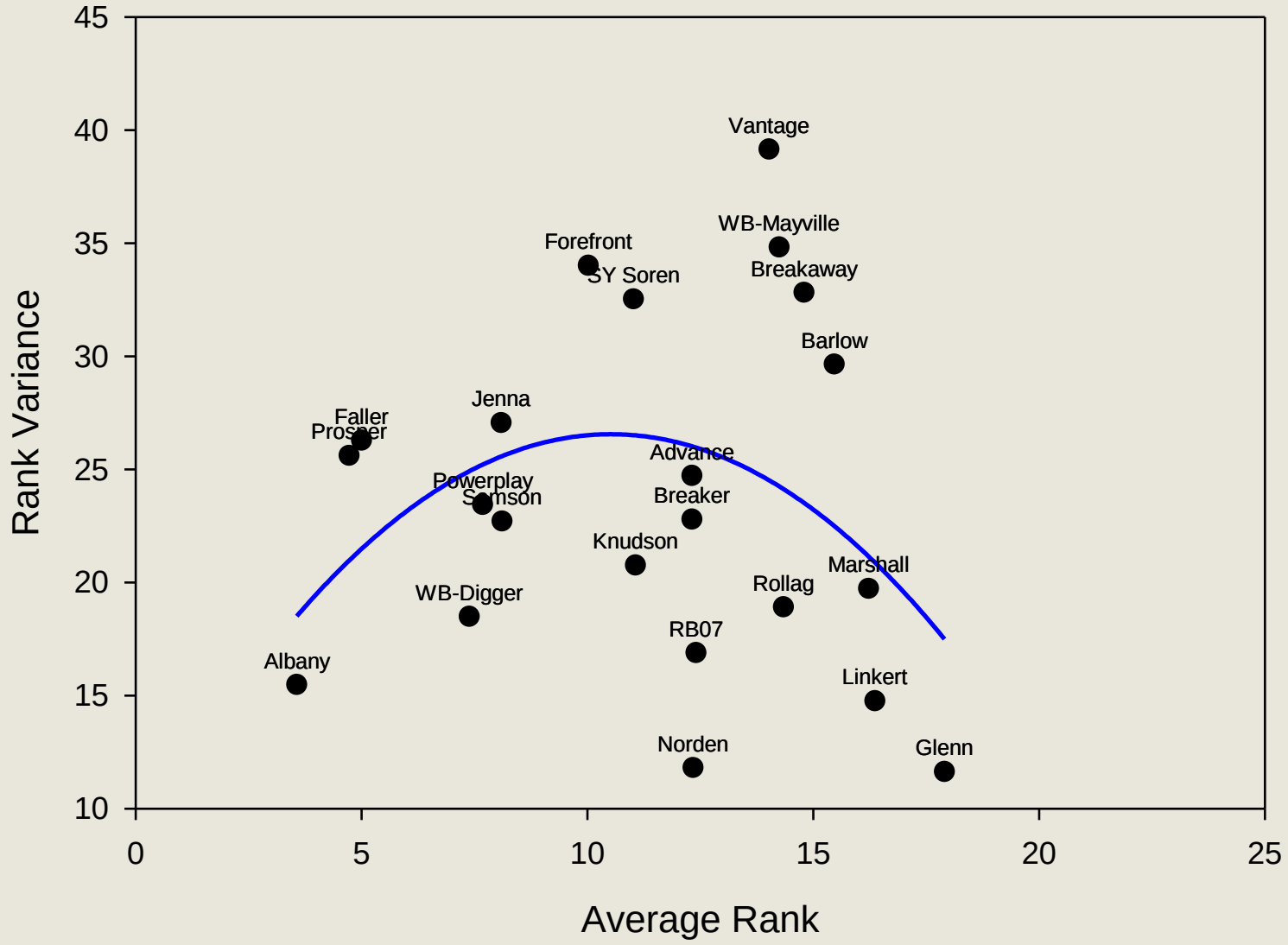
- Increased incidence since 2005. Why?
- No control options, some varietal differences

Entry	BLS
Prevail	2
Breaker	2
SY Rowyn	3
Forefront	3
Breakaway	3
SY Ingmar	3
Elgin-ND	4
Norden	4
Knudson	4
Linkert	4
Advance	4
SY Soren	4
LCS Iguacu	4
Rollag	4
Barlow	4
Glenn	4
Prosper	4
Faller	4
HRS 3361	4
WB-Digger	5
Jenna	5
Powerplay	5
Samson	5
LCS Albany	6
RB07	6
WB-Mayville	6
Marshall	6
HRS 3419	6
HRS 3378	6
WB9507	6
Vantage	7

Yield vs. Protein – Northern MN 2012- 2014



Yield Stability – Northern MN 2012 -2014



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)

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Transitioning Cereal Systems to Adapt to Climate Change

REACCH
Regional Approaches to Climate Change –
PACIFIC NORTHWEST AGRICULTURE

Thank you!

University of Idaho

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Pacific Northwest Farmers Cooperative

CHS

Monsanto