Lifelong Learning: What We Have Learned Breeding for Scab Tolerance

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Acknowledgements:

- HWWCP
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USDA ARS

U.S. Wheat & Barley Scab Initiative

Topics:

- The nature of the problem
- What we have learned
- Where we are going
- A glimpse of the future

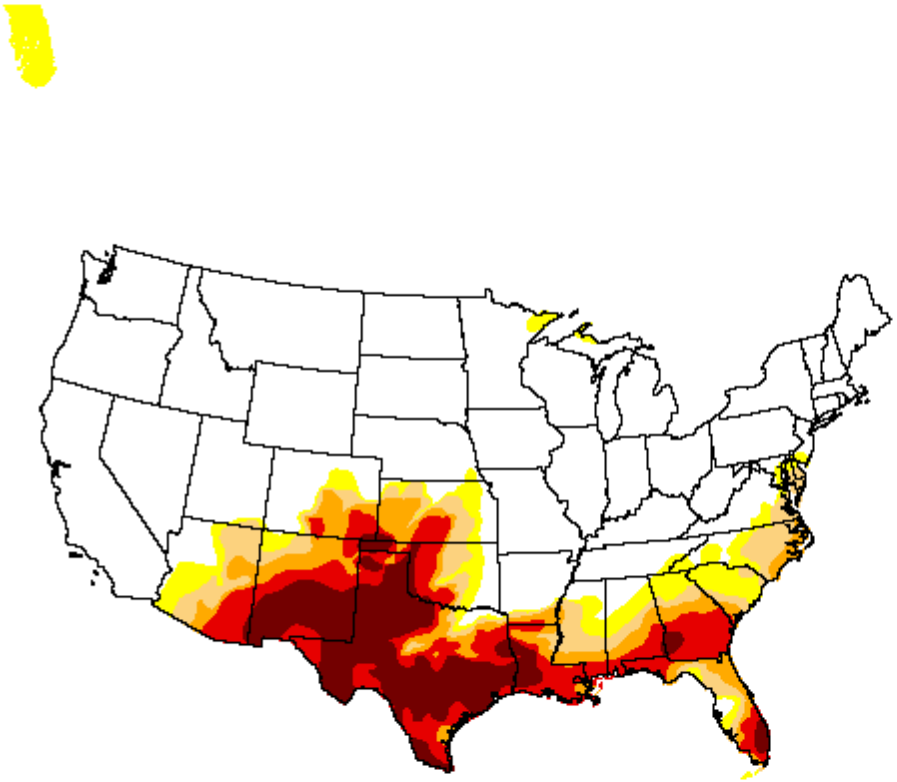
The Nature of the Problem:

- Scab is an episodic disease. The Great Plains region is prone to very erratic weather (extreme drought to extreme moisture).
- Corn is a major crop in much of region and many of our rotations are wheat, fallow, corn with minimum or no tillage. Corn residue is on the surface.
- The disease affected area is spreading, but limited by climate.
- Long generation times in winter wheat and a difficult assay.
- Frustrating disease to work with, so you have to be opportunistic and open minded—always learning.

The Corn-Fallow-Wheat System

Conservation Tillage

U.S. Drought Monitor
CONUS



June 7, 2011

(Released Thursday, Jun. 9, 2011)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	67.68	32.32	26.77	21.32	15.74	7.80
Last Week 5/31/2011	68.95	31.05	25.56	20.69	14.68	6.25
3 Months Ago 3/8/2011	59.25	40.75	27.48	12.56	2.68	0.00
Start of Calendar Year 1/4/2011	60.50	39.50	21.74	8.50	2.60	0.00
Start of Water Year 9/28/2010	60.05	39.95	13.16	3.09	0.30	0.00
One Year Ago 6/8/2010	78.36	21.64	9.04	2.96	0.48	0.00

Intensity:

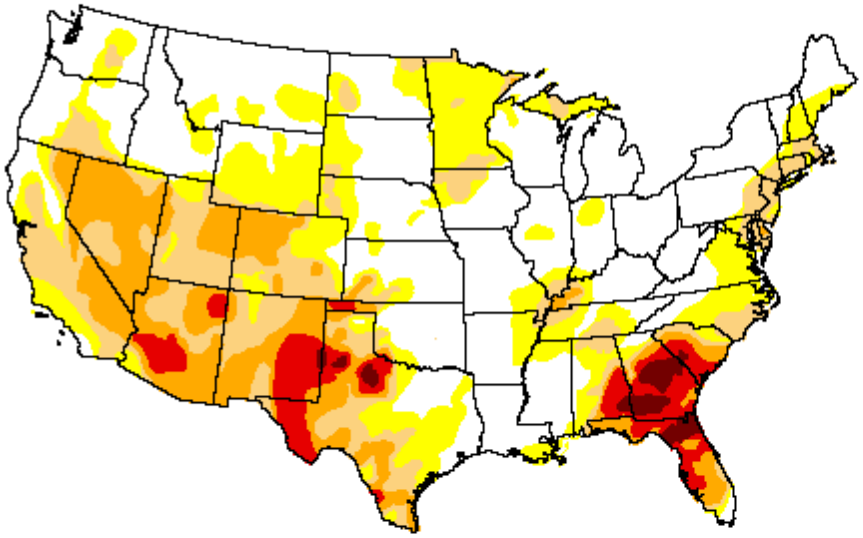
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author(s):
Matthew Rosencrans
CPC/NCEP/NWS/NOAA

http://droughtmonitor.unl.edu/

U.S. Drought Monitor
CONUS



May 15, 2012
(Released Thursday, May. 17, 2012)
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	45.21	54.79	33.64	18.39	5.71	1.02
Last Week 5/8/2012	43.88	56.12	35.88	19.65	6.77	1.61
3 Months Ago 2/14/2012	42.67	57.33	37.82	17.98	9.32	3.22
Start of Calendar Year 1/3/2012	50.41	49.59	31.90	18.83	10.18	3.32
Start of Water Year 9/27/2011	56.45	43.55	29.13	23.44	17.80	11.37
One Year Ago 5/17/2011	67.69	32.31	26.35	20.68	13.18	6.04

Intensity:

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Author(s):
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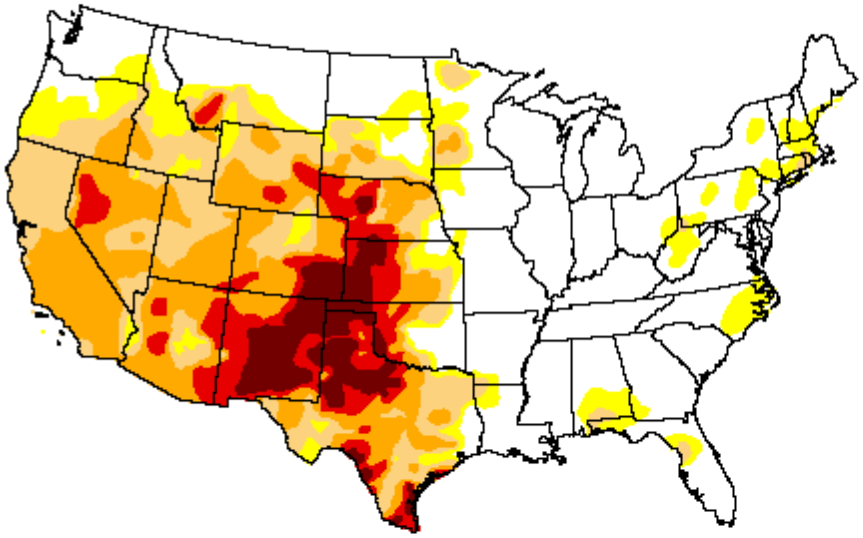
http://droughtmonitor.unl.edu/

U.S. Drought Monitor
CONUS



June 4, 2013

(Released Thursday, Jun. 6, 2013)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	45.02	54.98	44.11	28.49	11.44	4.79
Last Week 5/28/2013	43.13	56.87	44.34	29.56	11.75	4.74
3 Months Ago 3/5/2013	34.33	65.67	53.34	36.44	17.04	5.45
Start of Calendar Year 1/1/2013	27.22	72.78	61.09	42.05	21.31	6.75
Start of Water Year 9/25/2012	23.41	76.59	65.45	42.12	21.48	6.12
One Year Ago 6/5/2012	36.01	63.99	38.60	18.92	4.60	0.60

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author(s):
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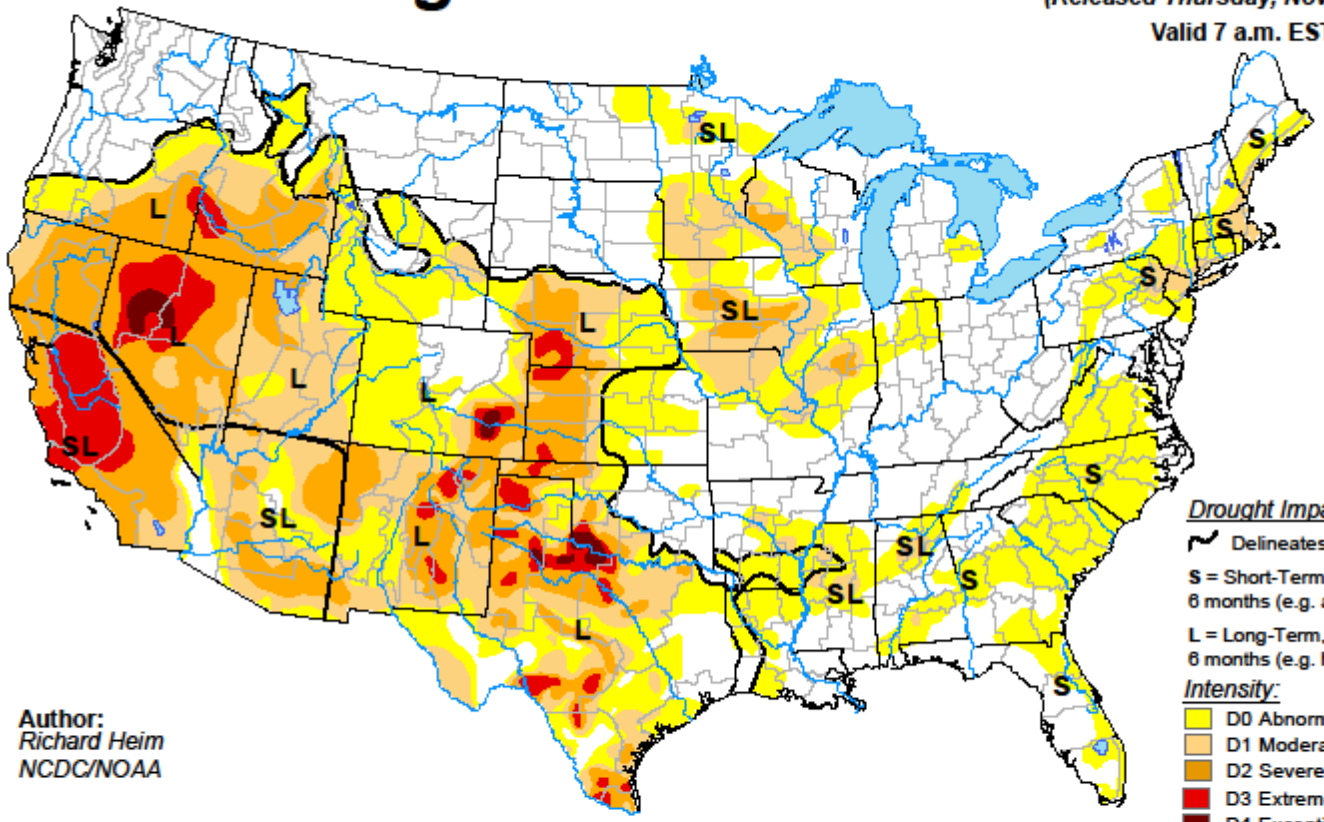
http://droughtmonitor.unl.edu/

U.S. Drought Monitor

November 19, 2013

(Released Thursday, Nov. 21, 2013)

Valid 7 a.m. EST



Author:
Richard Heim
NCDC/NOAA

Drought Impact Types:

Delineates dominant impacts

S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

- D0 Abnormally Dry
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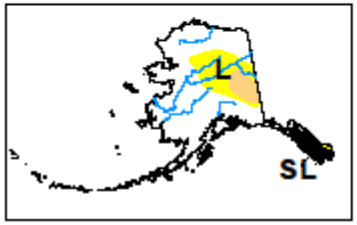
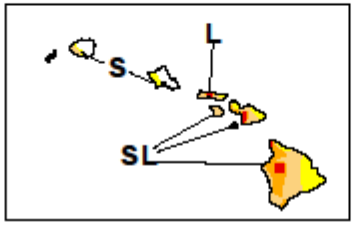
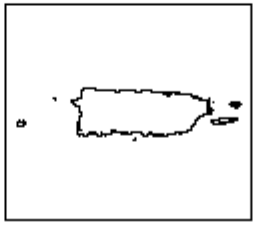






USDA

http://droughtmonitor.unl.edu/

What We have Learned:

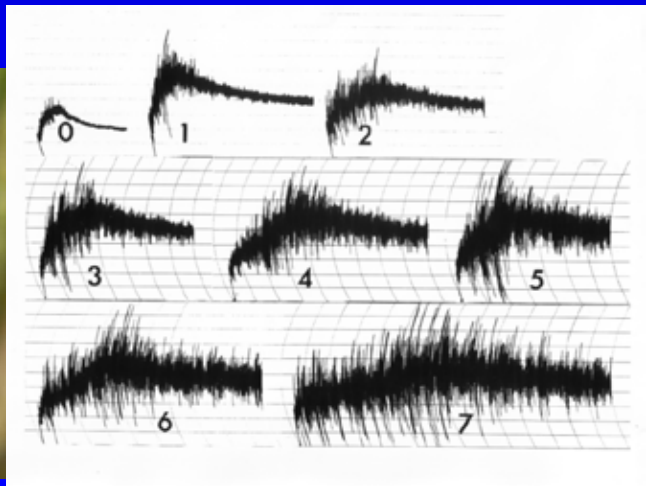
- You need a clearly defined target ("Better/Progress" is not good enough.)
- Regardless of your funding level, you have to use the funding wisely on a regional project basis.
- These are federal funds, you have to share freely—germplasm, nurseries, resources.
- You have to accept trends (cut your losses).

Our Target: By 2015

- 90% of the wheat grown in the affected areas will be resistant cultivars.
- The level of DON will 0.5 ppm (matching the European standard or the standard that is more stringent for the export market).
  ~50% of our wheat is exported
- The whole grain market is expanding so milling off the bran will not be an option for many of our products (1 ppm DON).

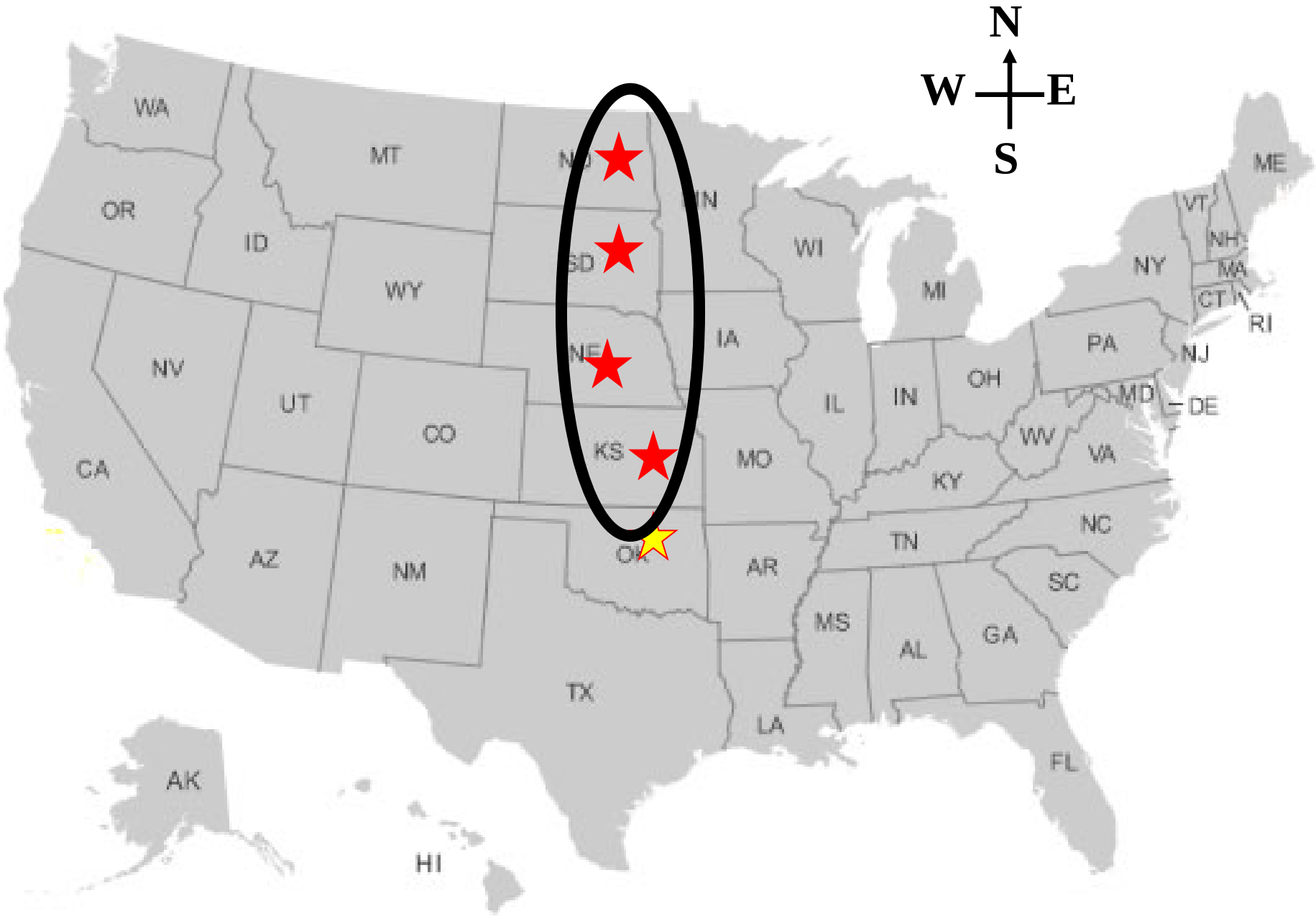
Our Strategy:

- Scab is one on many breeding objectives.
- The most effective strategy will couple genetic resistance with fungicide applications and sound management (organic market is growing). It has to be integrated.
- Breeders need defined targets.



Our Successes:

- Excellent cultivars with FHB tolerance available throughout the region.
- Cultivars were developed by public and private breeders—a necessary collaboration.
- None would have been found without funding from the Scab Initiative and the use of mist nurseries.
- None would have the data package on their resistance without the Scab Initiative.
- Set of FHB testing sites (for public and private testing) which span the region, but are very thin (4 sites). *We really appreciate the regional scab nursery effort.*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www.ScabSmart.org

Hard Red Winter Wheat

The varieties listed for each state are adapted for production in that state and have the best available resistance to head Fusarium head blight (FHB=scab). These varieties are known to have moderate levels of resistance to head scab, and should reduce the risk of severe yield losses and DON contamination.

Kansas	**Nebraska**	**South Dakota**	**North Dakota***
Art	Art	Everest	Lyman
Everest	Everest	Lyman	Overland
Hitch	Hitch	Overland	
Overland	Lyman		
T158	Millenium		* Reports
	Overland		Fungicide x G
	T158		

USDA ARS

U.S. Wheat & Barley
Scab Initiative

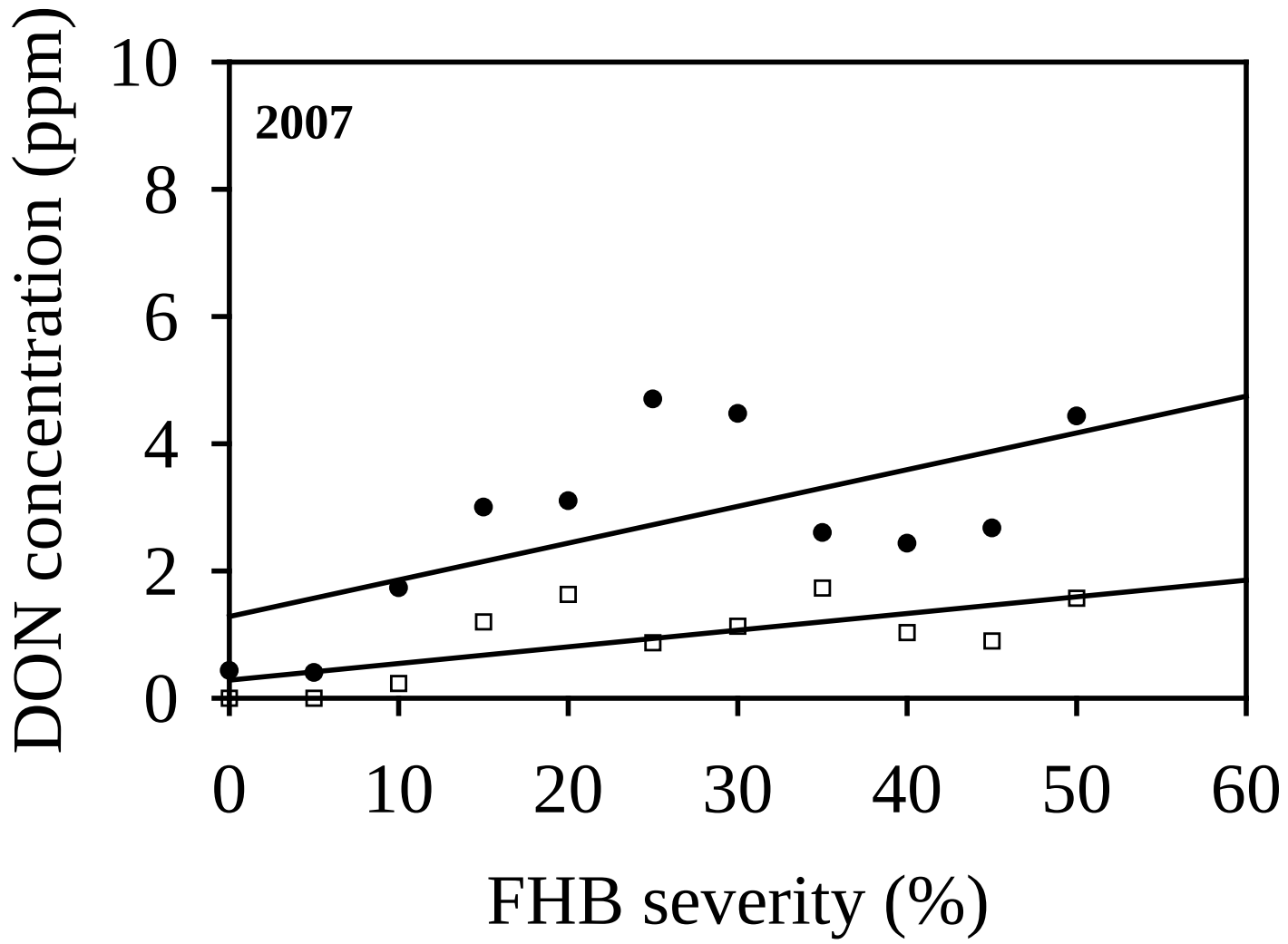
Breeding and Management:

- Growers have more choices and the choices are increasing.
- As major chemical/life science companies are moving into the hard winter wheat region, we have access to new germplasm (consider the European or global scab tolerant lines) and new chemistry.
- Public-Private collaboration is not only good, but essential.

The Role of DON:

- We have developed lines (Harry) with more DON at the same level of disease as other lines (2137).
- Disease in important, DON is key to our stakeholders.

Regression of DON on FHB severity, 2007



- **Harry: *Y = 1.28 + 0.06X; R^2 = 0.42, P = 0.0311***
- **2137: *Y = 0.41 + 0.02X; R^2 = 0.36, P = 0.0687***

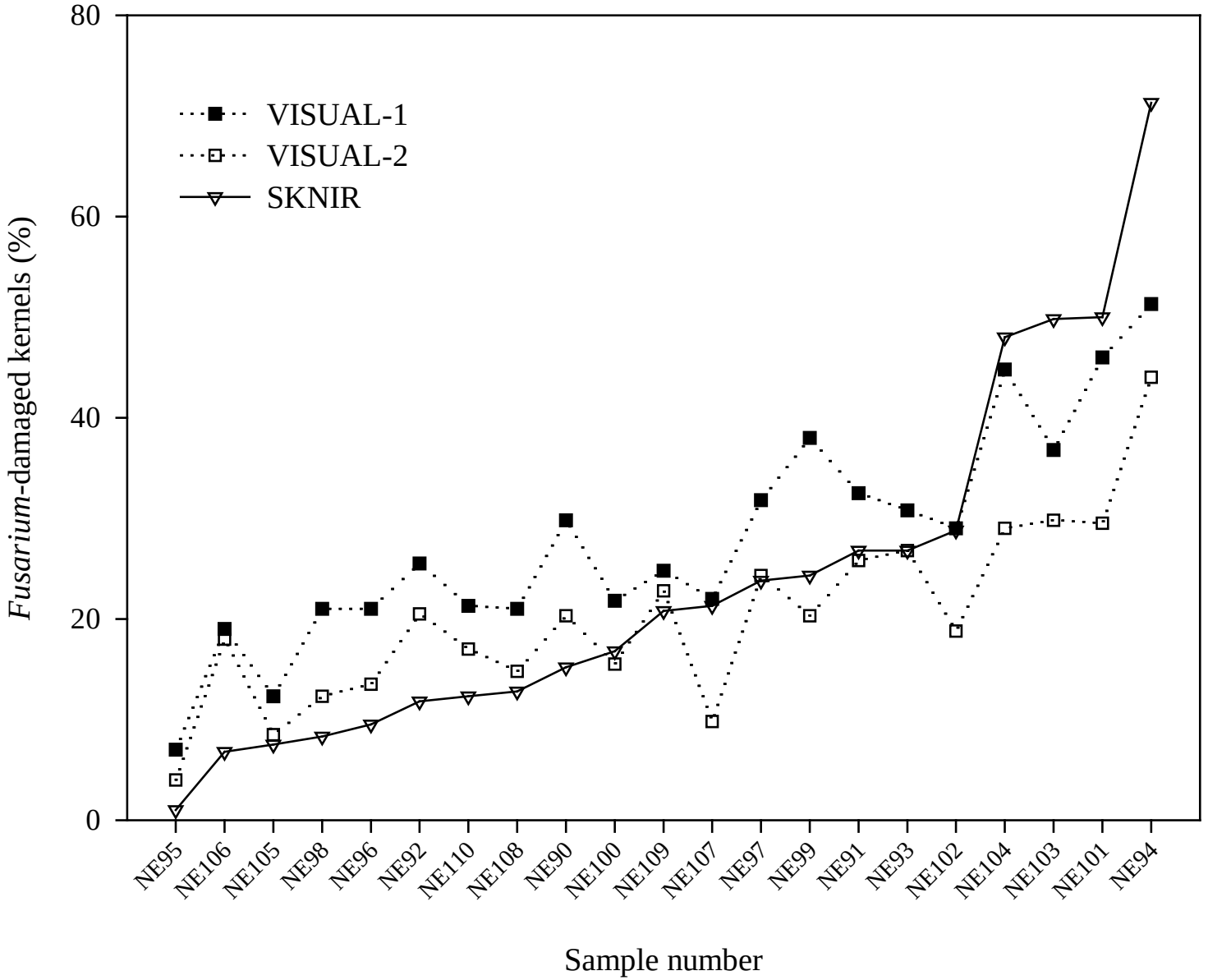
Where is Fhb1?

- Everyone of our of tolerant cultivars is based on native resistance.
- We have shown Fhb1 does not affect grain yield or quality.
- Wesley Fhb1 is being shared. Overland Fhb1 (shared next year) is under development as are other major Fhb genes/lines.
- Backcrossing and DH are being used to rapidly move Fhb QTLs into hard wheat.

Where are we Getting our Germplasm?

- Hard red and white winter wheat.
- Hard red and white spring wheat in preference to soft winter wheat.
  - Easier to remove the spring growth habit than the soft kernel aspect.
  - HRS has similar quality characteristics.
  - HRS has shorter generation time, hence should have greater progress.

Over- and underestimation of FDK by visual raters compared to the SKNIR system

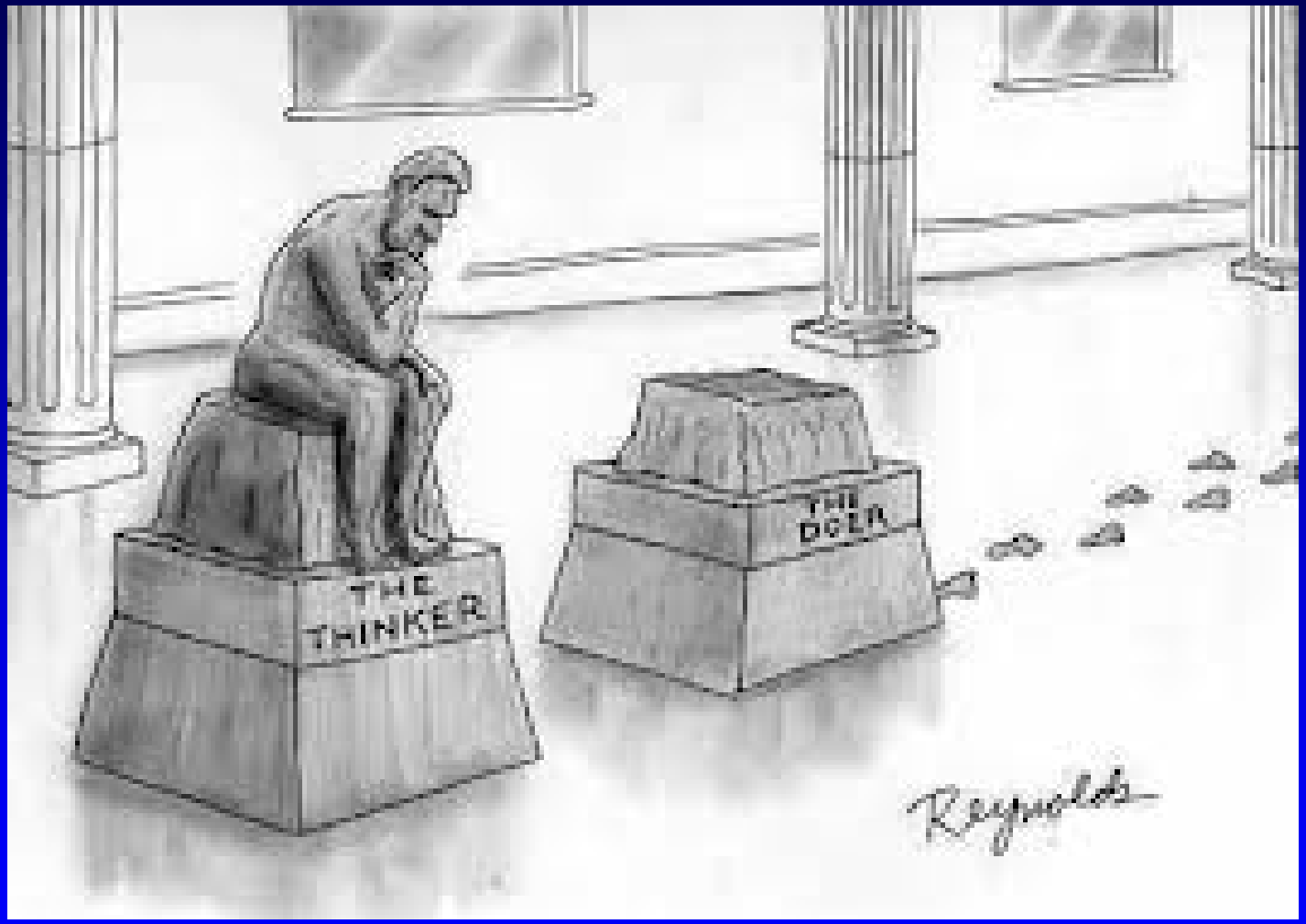


Where We are Going:

- Developing the needed germplasm with Fhb1 and the new sources from Bikram Gill's program in adapted backgrounds.
- Using DHs where appropriate to speed the process.
- Using molecular markers to help us understand our lines.
- Working with industry to support their and our grower needs.
- *More emphasis on the region and less on the state needs.*

A Glimpse Into the Future:

- Public-Private and Public-Public Collaboration will increase in that more private cultivars will be in the marketplace and better chemistry to control scab.
- Though projects will be assigned to states, our efforts will become more regional. *Who is best to make these decisions?*
- G x M (including fungicide) will become more important. Scab is an episodic disease.
- Better use of NIR technology (SKNIR).
- There is the real possibility of hybrid wheat and it remains to be determined how with its altered floral biology that will affect scab.


THE THINKER
THE DOER
Reynolds

If you want to go fast, go alone.
If you want to go far, go together.

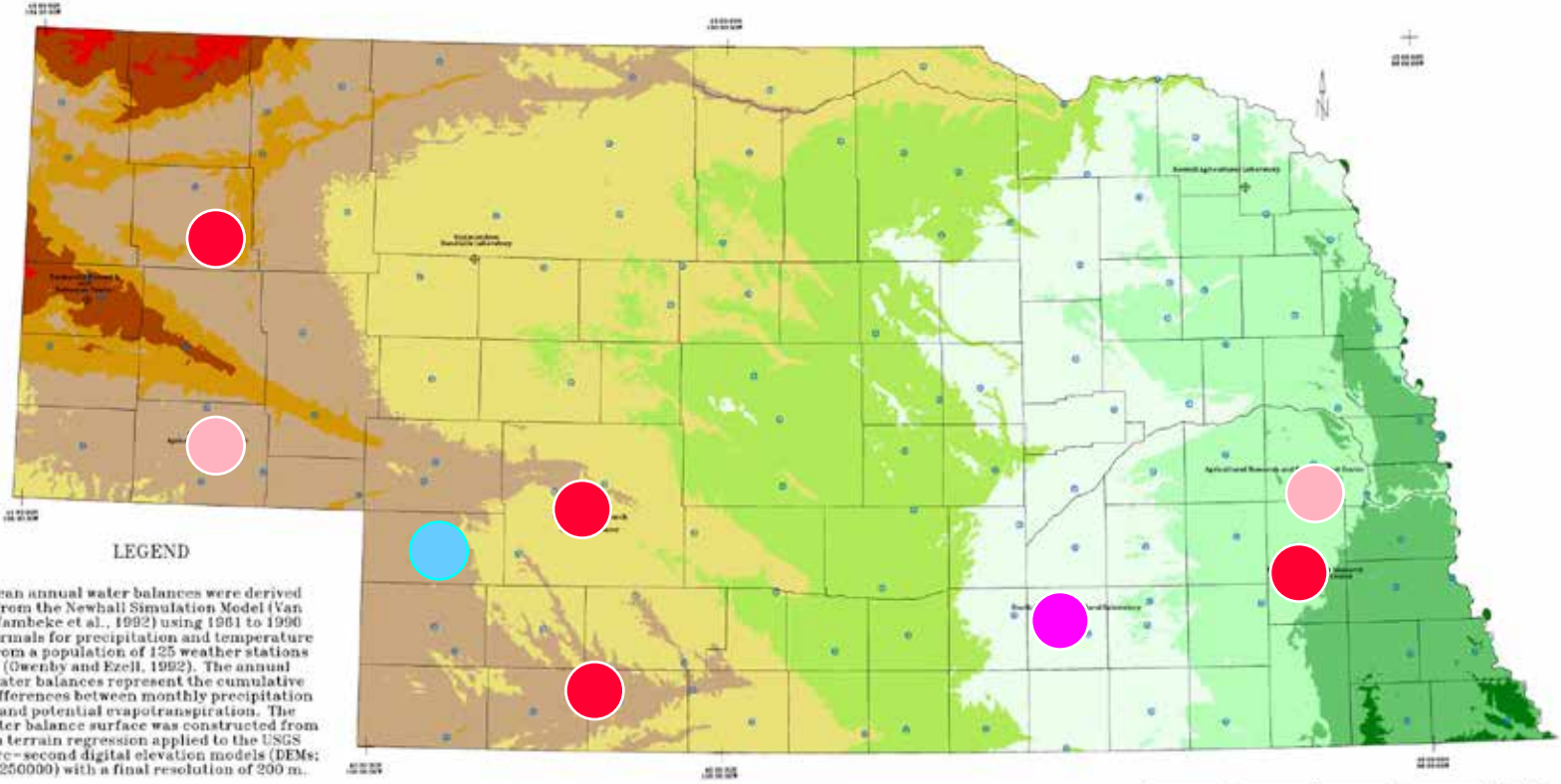
African proverb

The HWWCP thanks you for your attention.

UNIVERSITY OF NEBRASKA–LINCOLN

DEPARTMENT OF AGRONOMY AND HORTICULTURE

MEAN ANNUAL WATER BALANCE ACROSS NEBRASKA LANDSCAPES



LEGEND

Mean annual water balances were derived from the Newhall Simulation Model (Van Wambeke et al., 1992) using 1961 to 1990 normals for precipitation and temperature from a population of 125 weather stations (Owenby and Ezell, 1992). The annual water balances represent the cumulative differences between monthly precipitation and potential evapotranspiration. The water balance surface was constructed from a terrain regression applied to the USGS 3 arc–second digital elevation models (DEMs; 1:250000) with a final resolution of 200 m.

- 101 to 150 mm
- 51 to 100 mm
- 0 to 50 mm
- −1 to −50 mm
- −51 to −100 mm
- −101 to −150 mm
- −151 to −200 mm
- −201 to −250 mm
- −251 to −300 mm
- −301 to −350 mm
- Agricultural Research and Extension Site
- Weather Stations

A cooperative project of the Departments of Agronomy and Horticulture and Computer Science and Engineering, University of Nebraska–Lincoln. Milner, M., D.A. Mortensen, K.G. Cassman, and W.J. Waltman. 2000. Geospatial Applications for Nebraska Agriculture. Univ. of Nebraska Cooperative Extension CD 6. Albers Equal Area Projection.