Looking in Unexpected Places: Winter Barley in the Great Plains

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Topics:

- Nebraska Small Grains Breeding Program.
- Winter Barley in the Great Plains
- Climate & Policy Change: The trends and what is winter hardiness.
- Nebraska in the ‘overall scheme of things’.
- The Breeding Program
- A recent release

Nebraska Small Grains Breeding Program:

- Winter wheat: ~65% of all the wheat grown in NE was developed by the USDA-UNL breeding effort (NE lines sold in CO, KS, WY, SD, ND, and MN).
- Winter triticale: Feed and forage (sold from TX to MN)
- Winter barley: Feed, forage, food grains, and potentially malt (latter depends upon logistics) and ethanol. Sold from Texas to NE.

Winter Barley in the Great Plains

- Has a very long history of research. At one time there were breeding programs in TX, OK, KS, NE, CO, and ND (emphasizing winterhardiness).
- Barley CRIS project at UNL was 002—second one initiated.
- Major issue is *winter survival* in the northern Great Plains and competition from other small grains in the southern Great Plains.

Winter Barley in the Great Plains

- Currently there are two winter barley breeding programs left (NE and USDA-ARS emphasizing insect resistance) and one interested scientist in KS (helps immensely with testing). TX was the most recent program to close and they recently submitted their germplasm to the World Collection.
- An orderly phase out of breeding programs is critical.

Winter Barley in the Great Plains

- Uses:
  - A little winter malting barley research previously done at MO and OK. NE is initiating a small effort (mainly for germplasm development) based upon funding.
  - As a feed grain for livestock (currently 1/3 of crop, but increasing to ½ of the crop).
  - All small grains in the southern Great Plains are considered dual purpose (grazing and grain), often just grazing or haying if drought is severe. (currently 2/3 of barley crop is used as forage, but as the grain crop increases, proportion will change.

Winter Barley in the Great Plains

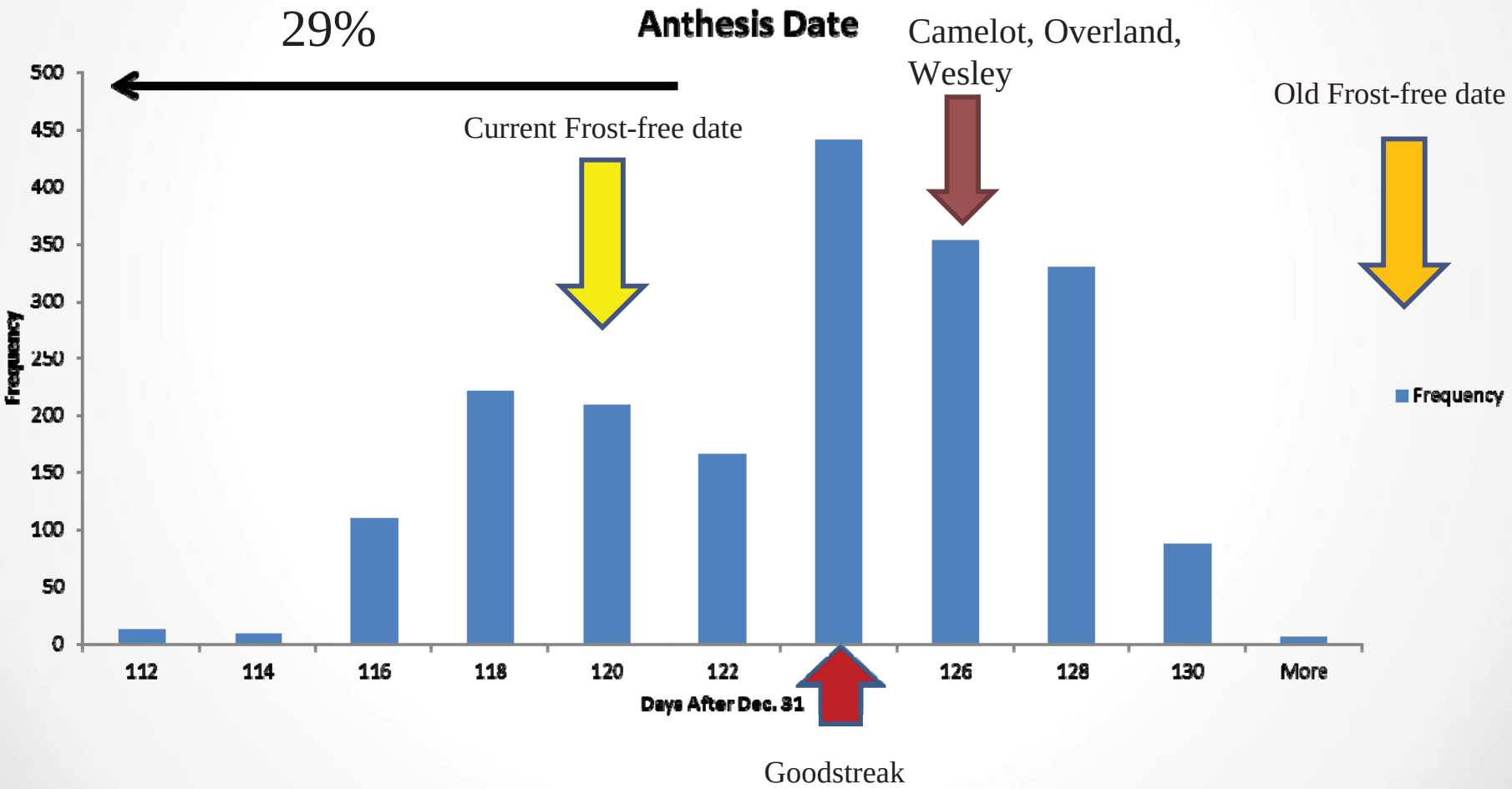
- Uses:
  - Barley as a rotational crop helps with disease suppression.
  - Barley is immune to Karnal bunt, a wheat disease in Mexico.
  - Future use include hydroponic barley growing where the cattle eat the roots as well as the stems and leaves.
  - Ethanol?

Winter Survival:

- Cold temperatures that cause ice crystal punctures in the cell.
- Heaving due to freezing and thawing.
- Desiccation winter kill—basically freeze drying (believed to be major cause of damage to wheat in Nebraska).
- *Breaking dormancy too early and being killed by a later freeze. The barley does not die in January or February, but is killed in March or April.*

Snow cover in western Nebraska: an open winter, exposed to cold temperature. Also exposed to wind and blowing. Note also the field variation due to variable snow cover.

Wheat Anthesis Date 2012



The Windstar Dilemma

- Windstar: Released in 1997.
- Excellent straw strength, grain yield, quality, stable plant height under stress, and wind erosion capabilities (does not get blown out of the soil).
- Most photoperiod sensitive line that I have seen.
- Previous earliest spring, flowering began 126 after Dec. 31, harvest at 160 after Dec. 31. Windstar flowered at 144 after Dec. 31. Harvested 16 days later.

The Importance of Delayed Flowering:

Winter Barley:

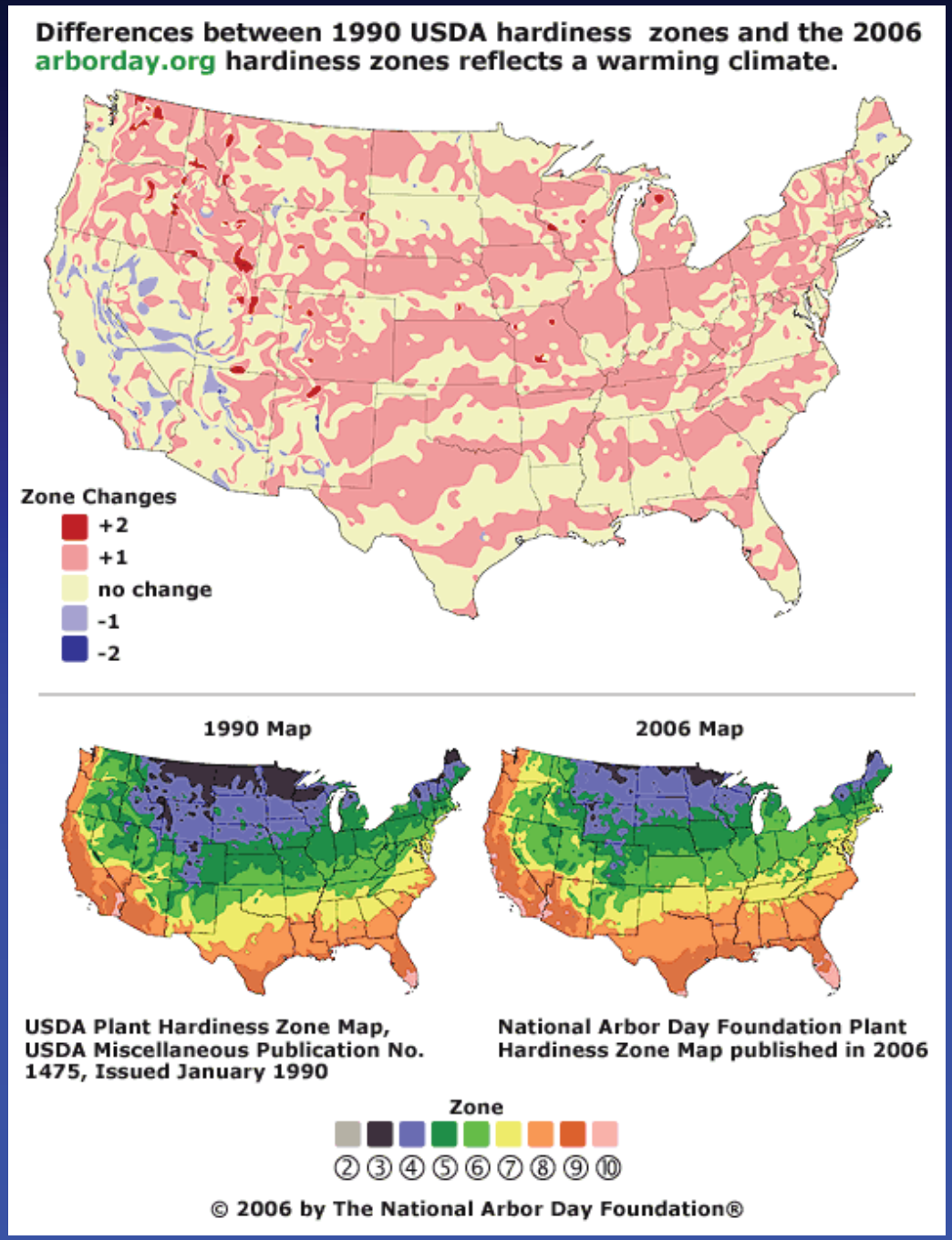
- Has the winterhardiness to survive most Nebraska winters.
- Climate change may be bringing this crop back to the Great Plains.
- Elongates rapidly and is winterkilled by late freezes (Nebraska, not further south).
- Need germplasm that does not elongate too soon. *May be more related to photoperiod sensitivity than vernalization.*

Vernalization vs. Photoperiod Sensitivity

- Dictoo and NB3437 both were winterhardy, but both were polymorphic for low (short) and high (long) vernalization types.
- The same was true for Centurk and Siouxland wheat.
- Assumed the winter has ample time for vernalization, vernalization is somewhat separate from winter survival, and that vernalization does not control breaking dormancy.

Role of Climate:

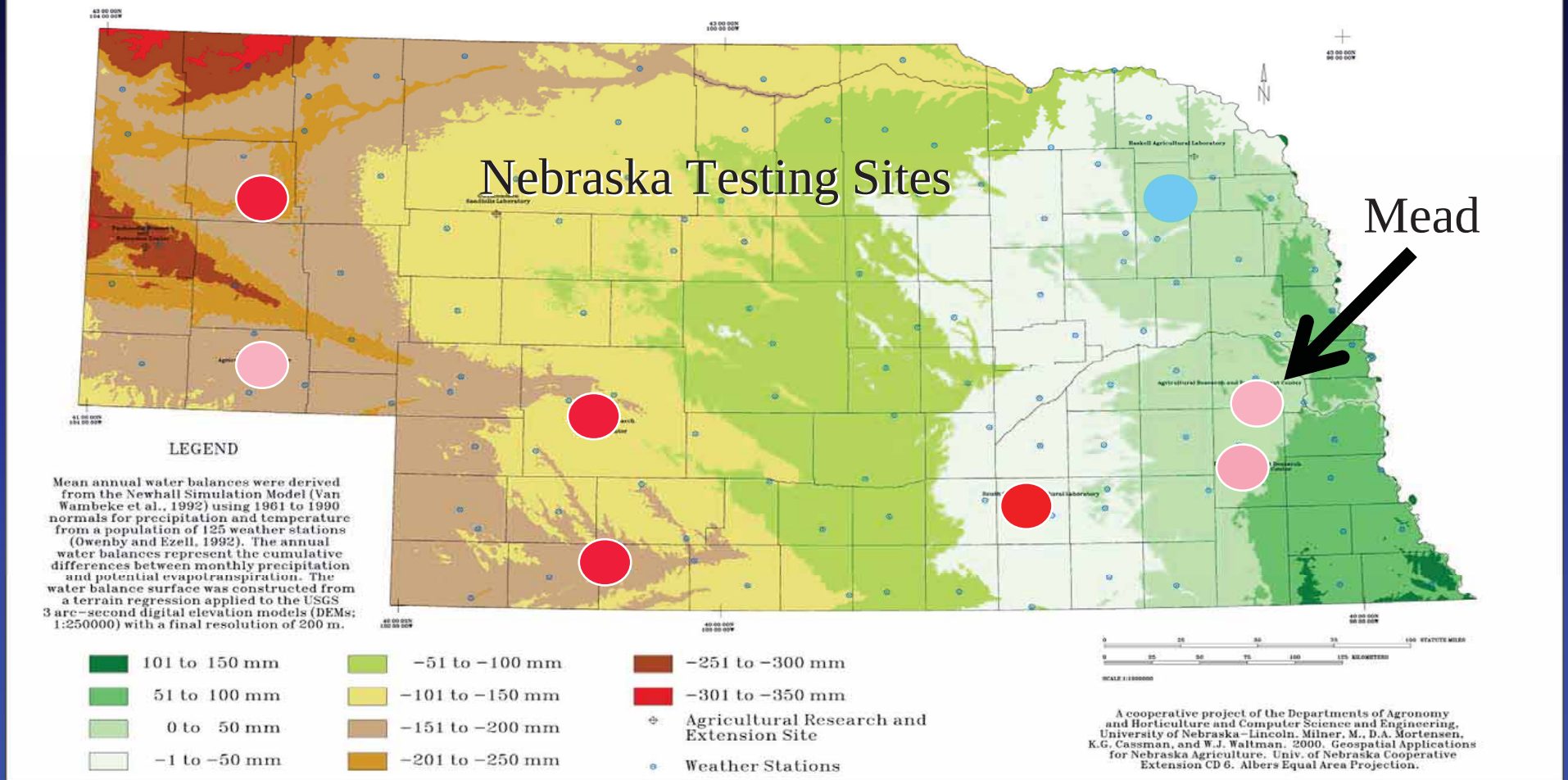
- We are getting warmer in the short term.
- May explain the reduced risk of growing and the better grain yield of barley.
- Barley is more drought tolerant than wheat, but of course this may change.



UNIVERSITY OF NEBRASKA–LINCOLN

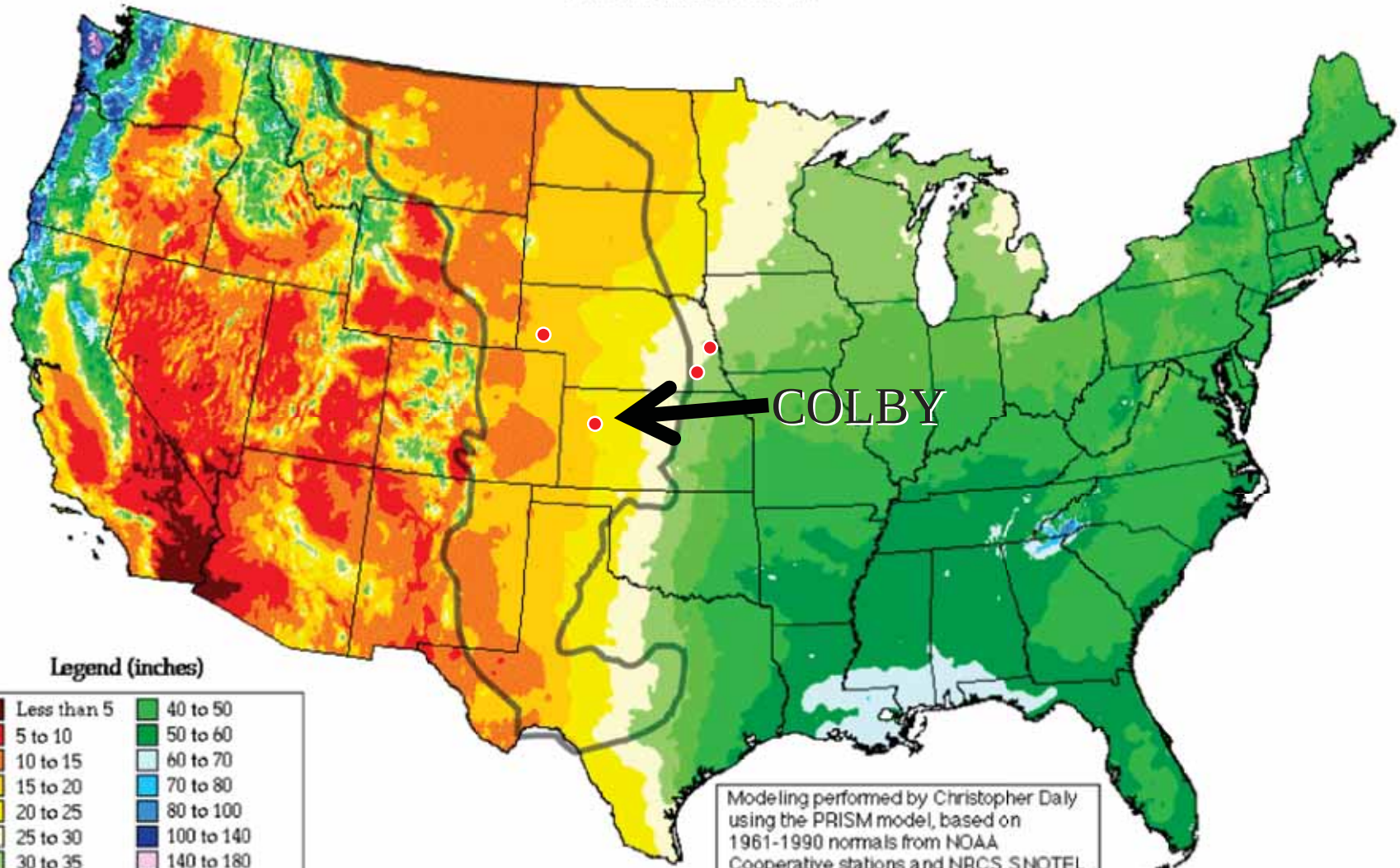
DEPARTMENT OF AGRONOMY AND HORTICULTURE

MEAN ANNUAL WATER BALANCE ACROSS NEBRASKA LANDSCAPES



Annual Average Precipitation

United States of America



Legend (inches)

Less than 5	40 to 50
5 to 10	50 to 60
10 to 15	60 to 70
15 to 20	70 to 80
20 to 25	80 to 100
25 to 30	100 to 140
30 to 35	140 to 180
35 to 40	More than 180

Period: 1961-1990

Modeling performed by Christopher Daly using the PRISM model, based on 1961-1990 normals from NOAA Cooperative stations and NRCS SNOTEL sites. Sponsored by USDA-NRCS Water and Climate Center, Portland, Oregon.

Oregon Climate Service
George Taylor, State Climatologist
(541) 737-5705

Selection for Winter Survival: Mead, NE. If it survives there, it will survive anywhere in the Great Plains.

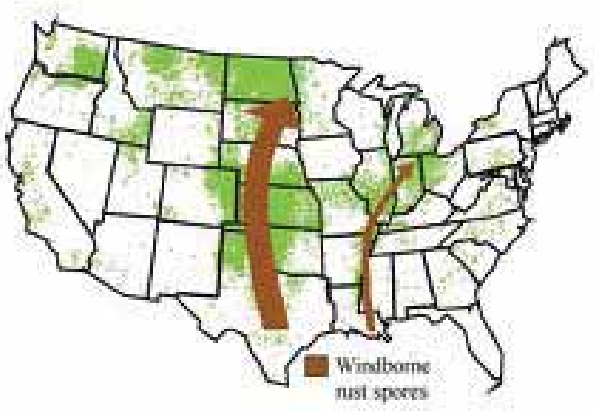
Role of Policy:

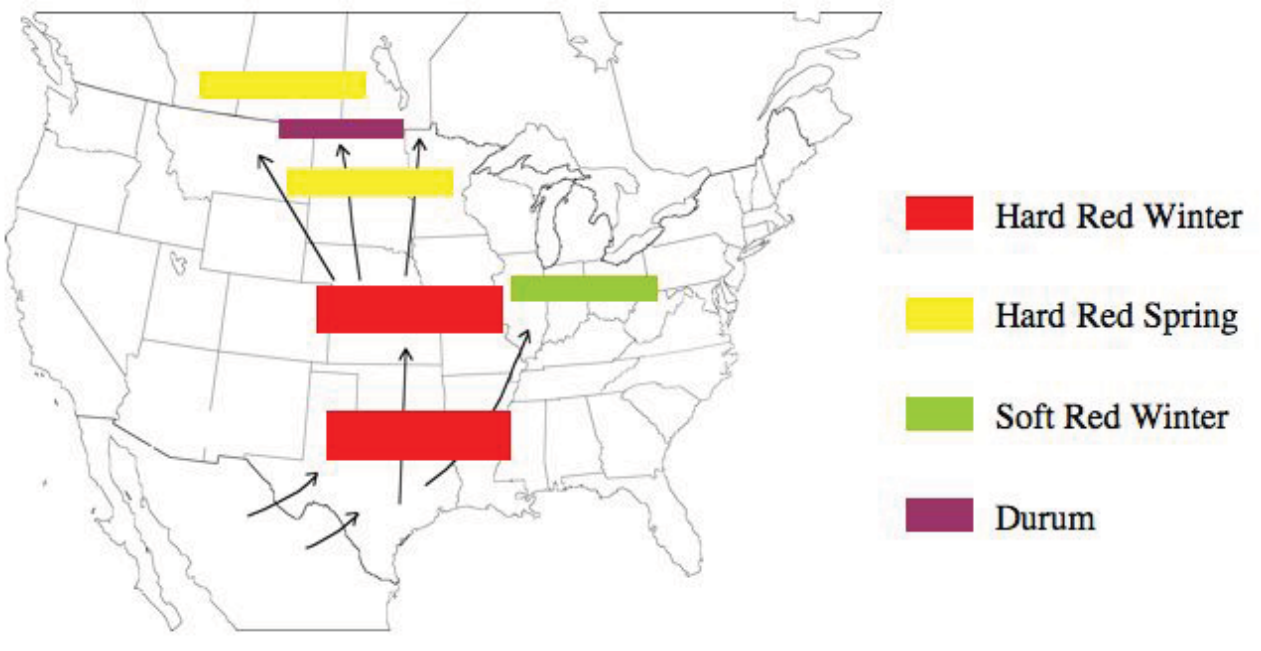
- Dairies are moving out of western U.S. to the more animal friendly Great Plains. Dairies like forage barley for feeding young calves.
- The current farm program insures barley-a recent addition. The barley insurance programs, due to recent good yields in the Great Plains, assumes very high yields compared to declining wheat yields under the drought.
- Parts of the Great Plains are feed grain deficient.

Great Plains Barley in the ‘Overall Scheme of Things’

- A unique set of testing environments.
- A unique market.
- An important source of diverse germplasm that has very high levels of winterhardiness.
- Nebraska and USDA-ARS are the last public breeding programs.
- We are a key link/shield between Mexico and the spring barley region (e.g. Puccinia pathway).

Puccinia Pathway: Same Pathway for Barley





The Southern Great Plains the link and shield along this pathway. We often see things first and the forage market can be less concerned about diseases.

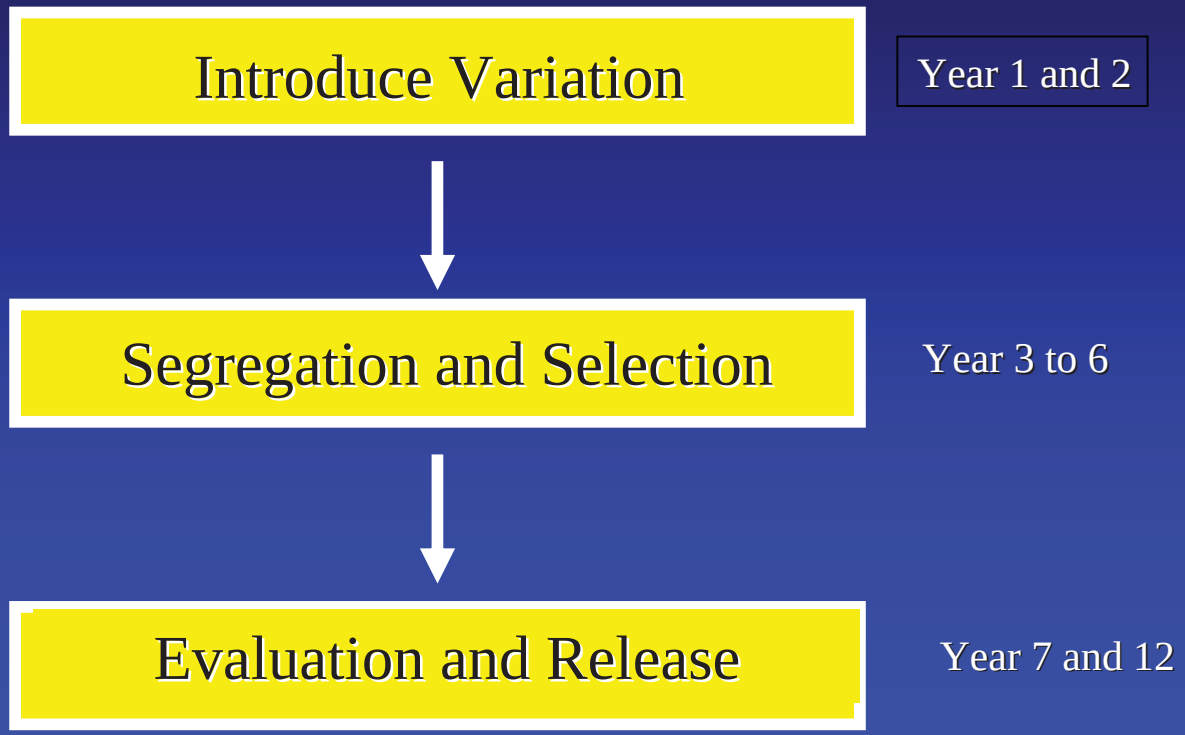
Winter Barley Releases:

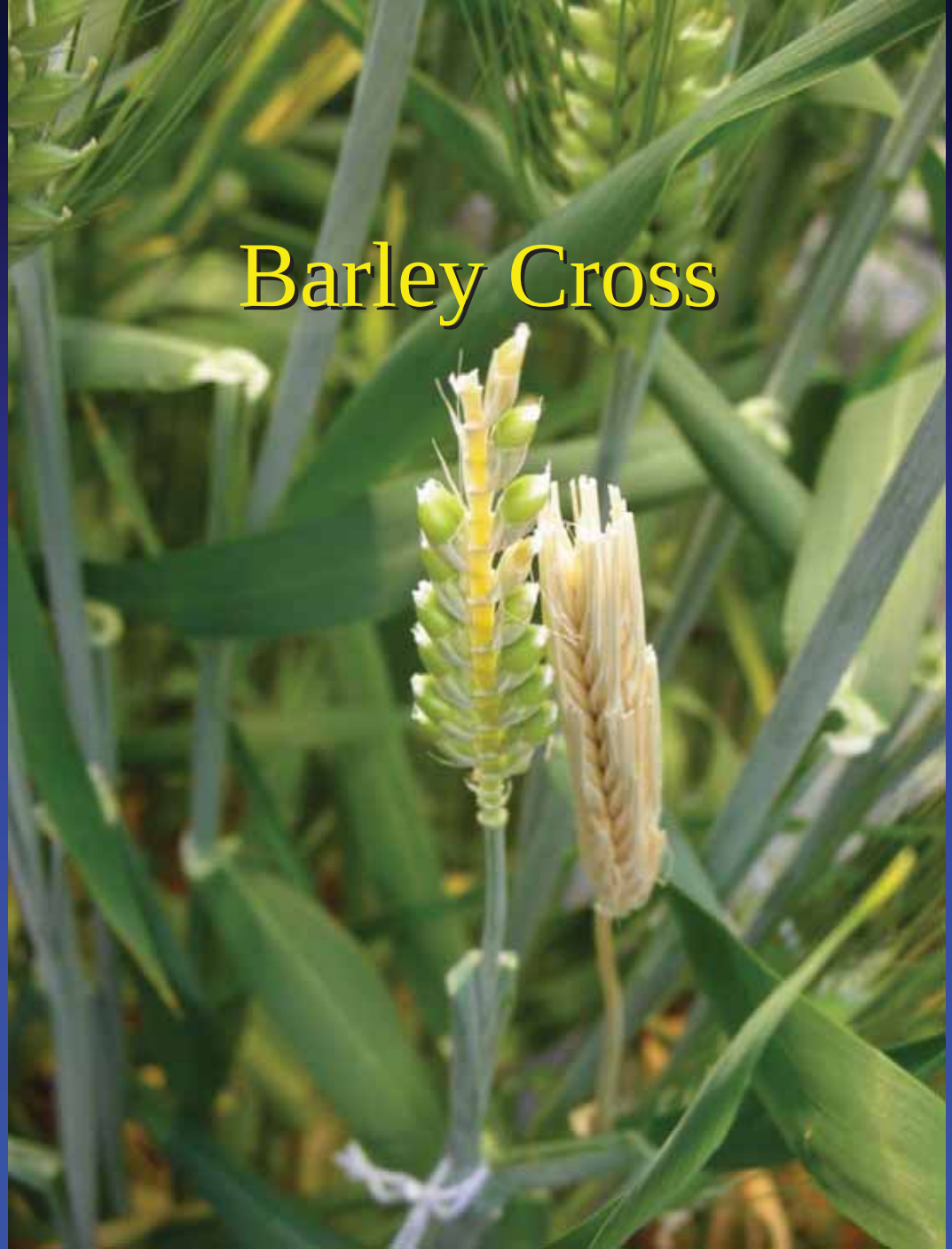
- NE exclusively released through Paramount Seeds Farm of Quinter KS and their associate network.
- Releases: Perkins (1990-general release), P-721 (1998), P-954 (1998), P-713 (2003), P-919 (2005), and P-845 (pending for 2013). Decision to release a line is based mainly on KS data and decision by Paramount on marketability.
- One pending from USDA-ARS via CO grower.
- Because their market is mainly KS and south, they can market some lines requiring less winterhardiness.

Paramount Barley Sales for 2012:

- Expected to be about 80,000 units (~80,000 acres of barley planted to new seed). More acres if you include famer-saved seed.
- Significant expansion. The forage market is very good because farmer saved seed is often less.
- Inquiries from Ohio west for barley seed.

Traditional Winter Wheat Breeding




Barley Cross

Barley Headrow Harvest

Barley Yield Trials at Sidney

Barley Trials at Mead, NE.

The effect of drought: Field Variation

New Release: P-845

- Krasnodar ‘K304/2’/NB90701
- NB90701=Sabbaton/Meimi*2/Decatur/3/Dundy// Nebar sel./Dundy/4/OK77422
- Highest yielding line in Colby and Lincoln, NE.
- Good winter hardiness.
- Average test weight.
- Relatively short compared commercially available cultivars.

P-845

	Linc.		Mead		Sidney		Colby			
	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Average	Rank
VARIETY	Lbs/a		Lbs/a		Lbs/a		Lbs/a		lbs/a	
	(7)	(7)	(5)		(5)		(8)		(25)	
P-713	4433	3	3426	1	3341	1	3909	2	3846	2
P-721	4029	4	3036	4	3330	2	3657	4	3572	4
P-954	4486	2	3231	3	2858	4	3692	3	3655	3
TAMBAR 501	3972	5	2307	5	2437	5	3367	5	3138	5
P-845	4849	1	3415	2	2887	3	4246	1	3977	1

Improvements For the Future:

- Fund the harvest at Colby and at Sidney.
- Expand the crossing block and the germplasm screen for parents.
- Return to Russia for germplasm search.
- Expand malting, 2-row, and hulless crosses.
- Develop a plan for whatever the future brings (continued barley research or an orderly shutdown.)


... a good past is positively dangerous
if it makes us content with the present
and unprepared for the future.
Charles Eliot

Small Grains Improvement Team

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Ken Vogel (USDA-ARS)

Barley:
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My graduate students

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Thank you