

CSU Wheat Breeding Program Update

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Outline

- Wheat streak mosaic virus (WSMV) – management and varietal resistance
- Irrigated wheat – management, variety testing, variety trial results
- Grain protein issues in the 2016 and 2017 wheat crop
- New and upcoming wheat varieties

 K-STATE Research and Extension	<h2>Wheat Streak Mosaic</h2>	
Department of Plant Pathology	MF3383	Wheat Disease
<p>Wheat streak mosaic is one of the most economically devastating wheat diseases in Kansas and the Great Plains. The disease is most common in the western portion of the state, with sporadic outbreaks in central and eastern Kansas.</p> <p>Symptoms Plants infected with the disease often have yellow leaves with contrasting green and yellow streaks</p>		<p>Quick Facts</p> <ul style="list-style-type: none"> Wheat streak mosaic causes a yellow discoloration of leaves. This discoloration is most intense near the leaf tip. Plants infected as seedlings are often stunted and have a reduced head size. Wheat streak mosaic can reduce yield by 20% to 50%.
<p><u>Web</u> bit.ly/2wjkwDD</p>		
<p><i>Figure 1. Wheat with symptoms of wheat streak mosaic. Infected plants often have bright yellow discoloration and are often smaller than healthy wheat. The diseased plants also may have a prostrate growth habit.</i></p>		<p><i>Figure 3. Wheat curl mites live in colonies on the upper surface of the leaf where the leaf's edges curl around them due to their feeding. Adult, immature, and egg stages magnified 220x (left). Close-up of a female wheat curl mite (smaller than 0.03 mm).</i></p>

Wheat Curl Mite

- Primary role in virus transmission (*vector*)
 - Wheat streak mosaic virus (*WSMV*)
 - Wheat mosaic virus (*WMoV*, aka High Plains Virus)
 - Triticum mosaic virus (*TrMV*)
 - A single wheat curl mite can carry all three viruses at once and can simultaneously transmit them to the same wheat plant
 - A wheat plant carrying *WSMV* + others will typically show much more severe symptoms than a plant with *WSMV* alone
- Management – no available chemical options as with stripe rust!
 - *Control volunteer* to eliminate/reduce curl mite populations
 - *Delayed planting* to reduce curl mite movement into wheat
 - *Wheat variety selection*

Varietal Resistance for WSMV

- Resistance to the wheat curl mite – “slim pickings”
 - Two common sources: chromosome 1A, chromosome 6D
 - TAM 112, TAM 204: both sources
 - Avery, Byrd, Langin: 6D source only
 - Resistance may not be so effective under very high curl mite pressure (as in western Kansas in 2017)
- Resistance to the viruses – “slimmer pickings”
 - Three available sources: *Wsm1*, *Wsm2*, *Wsm3*
 - *Wsm1* – effective against WSMV+TrMV: *Mace (NE)*
 - *Wsm2* – effective against WSMV only: *Oakley CL*, *Joe (KWA)*
Snowmass (PlainsGold)
 - *Wsm3* – effective against WSMV+TrmV, not temp-sensitive



Burlington CO - June 2017

Field Resistance and Susceptibility Ratings

Data from Kirk Broders, CSU Plant Pathologist

Description of Winter Wheat Varieties in Eastern Colorado Dryland and Irrigated Trials (2017)

Name, Class, and Pedigree	Origin	RWA*	HD	HT	SS	COL**	YR	LR	WSMV	TW	MILL	BAKE	Comments
Antero Hard white winter KS01HW152-1/TAM 111	CSU 2012	5	5	7	8	5	2	7	5	5	4	6	CSU release (2012), marketed by PlainsGold. Medium height and maturity, good test weight, fair straw strength, good resistance to stripe rust. Moderate sprouting tolerance.
Avery Hard red winter TAM 112/Byrd	CSU 2015	5	6	7	7	5	6	7	3	4	4	3	CSU release (2015), marketed by PlainsGold. Doubled haploid-derived line, similar to Byrd with higher yield potential, larger kernels and slightly improved quality. Carries wheat curl mite resistance from TAM 112 parent. Moderately susceptible to stripe rust.
Brawl CL Plus Hard red winter Teal 11A/Above//CO99314	CSU 2011	5	2	6	3	9	5	5	7	4	4	3	CSU release (2011), marketed by PlainsGold. Two-gene Clearfield wheat. Excellent test weight, straw strength, milling and baking quality. Early maturity, medium height, long coleoptile. Intermediate reaction to both stripe rust and leaf rust.
Byrd Hard red winter TAM 112/CO970547-7	CSU 2011	5	4	6	7	6	7	7	2	4	3	2	CSU release (2011), marketed by PlainsGold. Excellent drought tolerance and quality. Average test weight and straw strength. Moderately susceptible to stripe rust. Carries wheat curl mite resistance from TAM 112 parent.

More resistant or tolerant

- Avery (3)
- Byrd (2)
- Denali (3)
- Joe (3)
- Oakley CL (2)
- Snowmass (3)

More susceptible

- Brawl CL Plus (7)
- SY Monument (8)
- Sunshine (8)
- WB-Grainfield (8)
- Thunder CL (9)

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<http://bit.ly/2w54m12>

Colorado Wheat Variety Database

Database Main Page Wheat Variety Information Single Location Trial Data Multiple Location Trial Data Head-to-Head Comparisons

Welcome!

The CSU Crop Variety Testing Program, under the leadership of Dr. Jerry Johnson, annually conducts winter wheat variety trials at multiple locations throughout Colorado. The Colorado Wheat Variety Database provides complete access to variety information and data from these trials in addition to official state variety trials in adjacent states (Kansas, Nebraska, Wyoming).



The database may be used to find up-to-date wheat variety information, display data from individual trial locations, generate summaries across multiple trial locations and years, and generate head-to-head comparisons for varieties of interest. Click any of the above tabs to get started!

Now updated with all 2017 Colorado, Kansas, Oklahoma, and Nebraska Variety Trial data!



<http://ramwheatdb.com>

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Wheat Variety Information

To search by variety name, select a variety and a display method on the right and click "Display." To compare two different varieties, select another variety from the second drop-down menu.

First variety

Second (optional)

Display

To search by variety characteristics, specify the desired search criteria and display method, and click "display."

Market Class

Heading RWA Test Weight

Height Leaf Rust Protein

Coleoptile Stripe Rust Milling

Straw Wheat Streak Baking

Show Key for Trait Scores

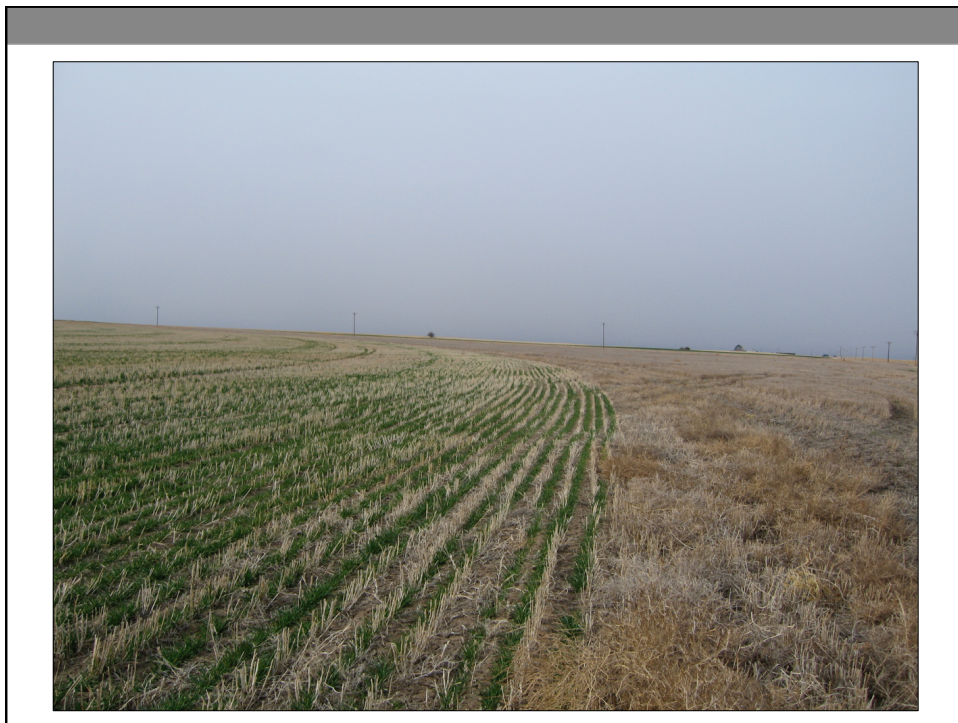
Display

Colorado Wheat Variety Database

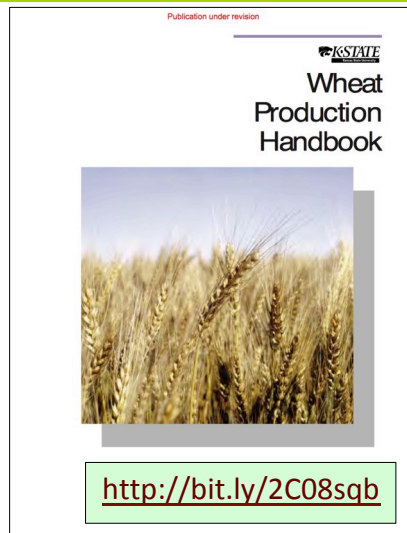
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Wheat Variety Summary

Suscept to Rusts														
Market Class	Year	Origin	Heading	Height	RWA	Leaf Rust	Stripe Rust	Wheat Streak	Test Weight	Protein	Milling	Baking		
Avery	--	CSU 2015	6	7	5	7	5	8	7	3	4	7	4	3
Byrd	--	CSU 2011	4	6	6	7	5	8	7	2	4	7	7	3
Clara CL	HW CL1	KSU 2011	5	5	5	6	5	2	5	2	2	2	4	4
Denali	--	CSU 2011	8	7	5	5	7	7	7	3	2	7	4	6
Joe	HW	KSU 2015	7	7	3	7	5	2	1	3	4	6	4	5
Mace	--	NE-JSOKA 2007	7	4	1	2	5	4	2	1	9	3	6	3
Oakley CL	CL1	KSU 2013	6	5	9	8	5	1	2	4	2	4	2	4
Rail	HW	KSU 2008	6	1	5	--	5	9	7	2	2	6	6	4
Snowmass	HW	CSU 2009	5	7	4	8	5	6	6	3	4	8	6	2
TAM 204	--	TX 2014	6	3	7	2	5	6	2	3	9	2	7	4

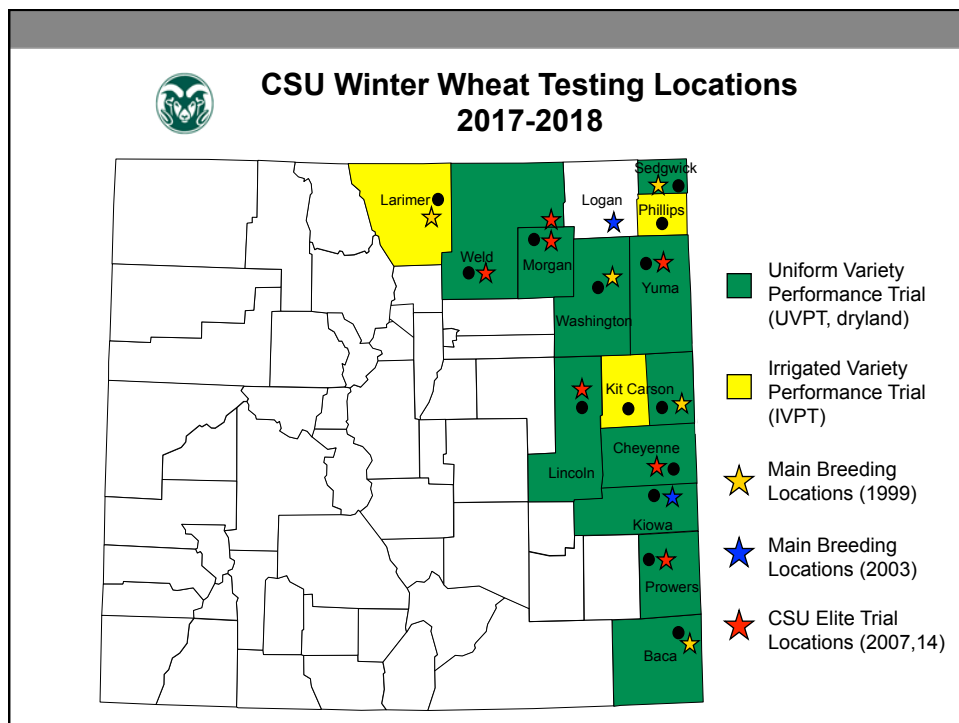


How to Achieve Higher Irrigated Yields?



Factors Affecting Irrigated Wheat Yield

- Planting date, seeding rate
- Water management – amount and timing
- Fertility management – amount and timing
- Fungicide – stripe rust, powdery mildew control
- Growth regulator – *Moddus*, *Palisade* (trinexapac-ethyl)
- Wheat variety – yield potential, straw strength, disease resistance, quality incentives



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<http://bit.ly/2w54m12>

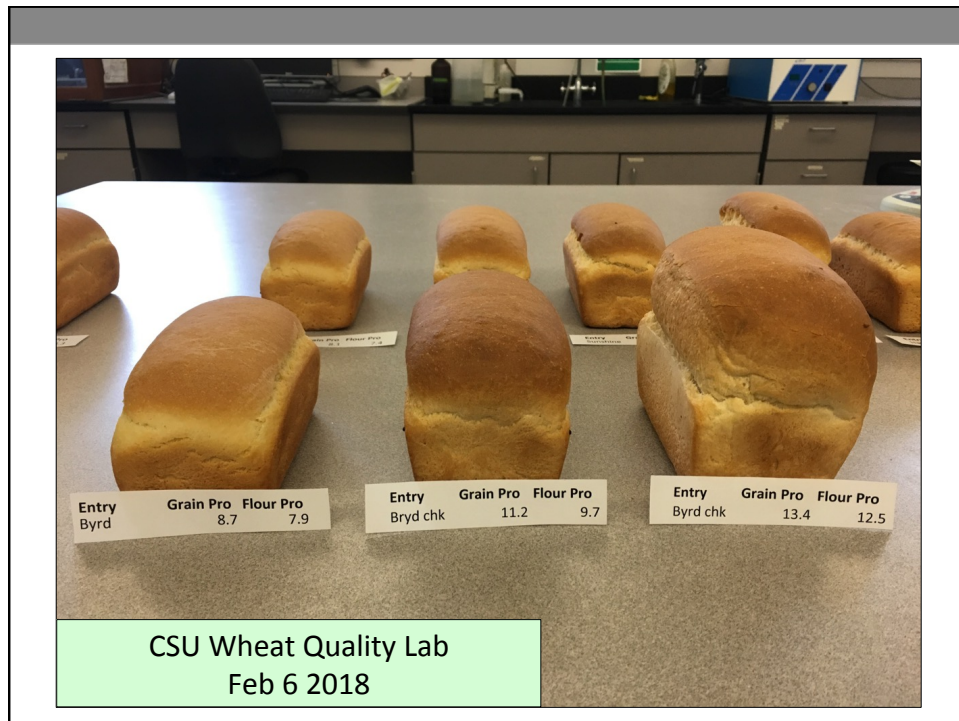
Summary of 2017 Irrigated Variety Performance Results

Variety ^b	2017 Individual Trial Yield ^a			2017 Multi-Location Average			
	Burlington	Fort Collins	Haxtun	Yield	Yield	Test Weight	Lodging
		bu/ac		bu/ac	% of avg	lb/bu	scale (1-9) ^c
SY Wolf	115.9	102.3	74.1	97.4	104%	57.0	3
WB4303	108.0	108.2	72.0	96.1	103%	55.3	2
Denali	106.8	105.0	74.6	95.5	102%	58.5	4
Byrd	110.1	96.2	78.8	95.1	102%	58.2	5
Langin	114.4	87.8	82.4	94.8	102%	57.9	5
KanMark	111.6	103.0	68.5	94.4	101%	58.0	3
Cowboy	109.4	103.7	67.8	93.6	100%	55.1	8
SY Sunrise	110.9	94.3	73.1	92.8	99%	58.9	5
Brawl CL Plus	113.3	83.5	75.4	90.7	97%	58.1	2
Avery	98.0	91.4	79.9	89.8	96%	57.0	8
Larry	110.4	96.0	60.7	89.0	95%	57.1	4
Sunshine	116.1	74.4	74.1	88.2	95%	56.2	5
Thunder CL	109.5	85.8	57.9	84.4	90%	57.6	1
WB-Grainfield	106.2	78.1	67.1	83.8	90%	58.8	4
Antero	92.7	77.8	79.8	83.4	89%	58.0	7
WB4458	99.4	88.0	61.4	83.0	89%	56.3	2
Experimentals							
CO13D1383	127.9	116.5	82.5	109.0	117%	58.6	2
CO12D296	112.0	118.7	86.8	105.8	113%	58.6	5
CO13D0787	111.7	104.0	97.0	104.2	112%	59.2	5
CO13D1299	124.5	103.8	82.9	103.8	111%	58.2	4

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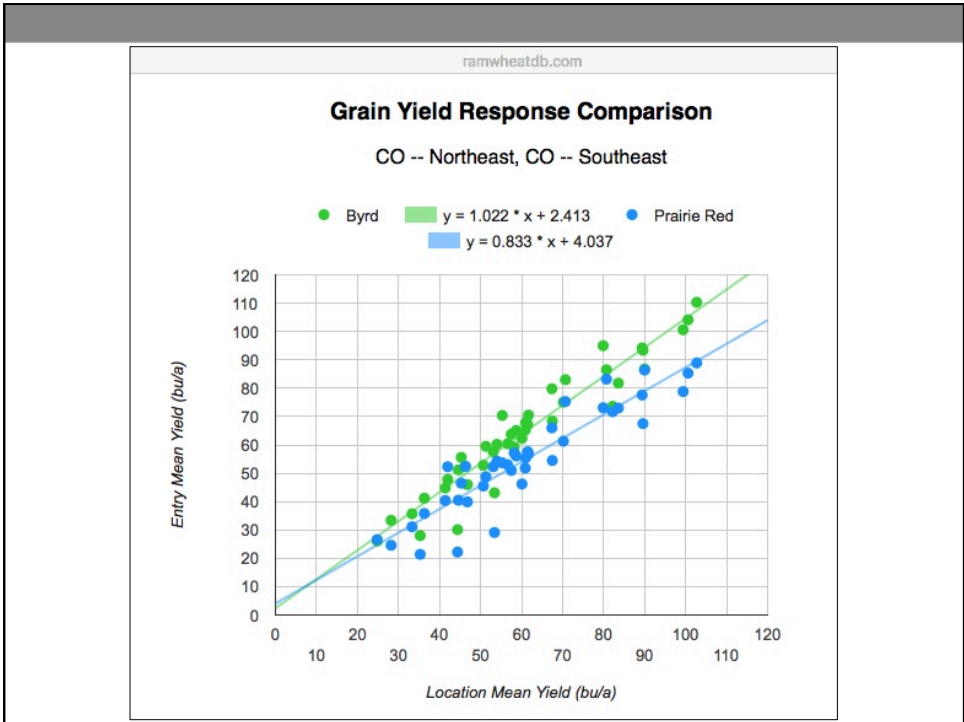
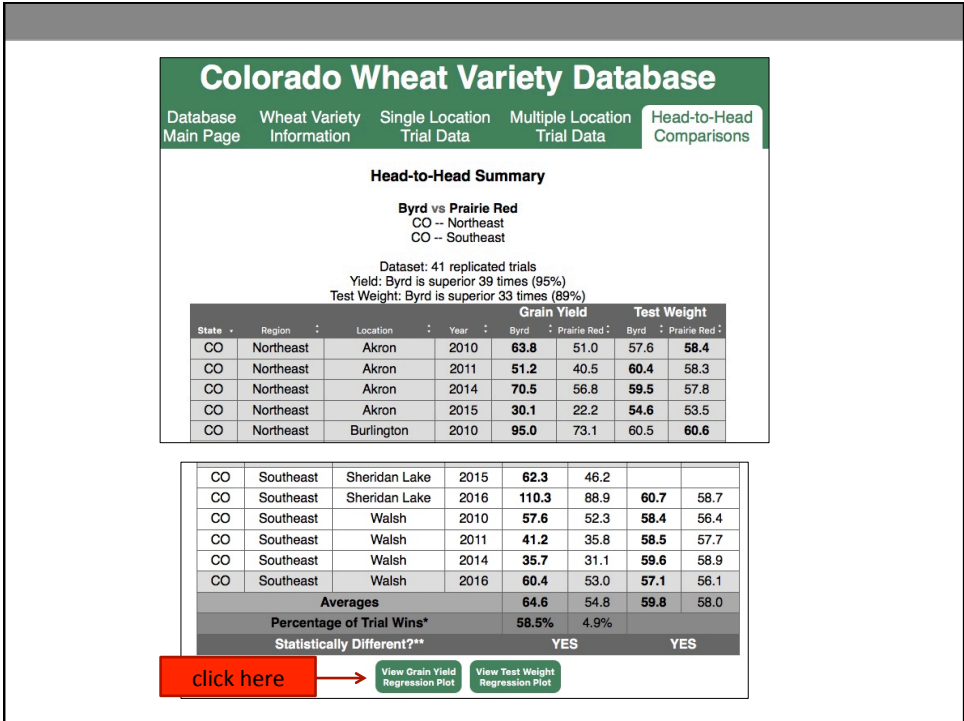
Summary of 3-year (2015, 2016, and 2017) Irrigated Variety Performance Results

Variety ^b	Brand/Source	Market Class ^c	3-Year Average ^a				
			Yield	Yield	Test Weight	Plant Height	Lodging
			bu/ac	% trial average	lb/bu	in	scale (1-9) ^d
Denali	PlainsGold	HRW	92.5	108%	58.5	39	4
SY Sunrise	AgriPro Syngenta	HRW	91.2	106%	58.8	35	3
SY Wolf	AgriPro Syngenta	HRW	90.3	105%	56.3	37	3
Langin	PlainsGold	HRW	88.1	102%	57.5	36	6
KanMark	Kansas Wheat Alliance	HRW	86.4	101%	57.0	33	2
Byrd	PlainsGold	HRW	85.2	99%	57.4	37	6
Brawl CL Plus	PlainsGold	HRW	84.1	98%	57.7	37	2
Sunshine	PlainsGold	HWW	83.8	97%	55.0	35	5
Avery	PlainsGold	HRW	83.6	97%	56.9	38	7
Cowboy	Crop Research Foundation of WY	HRW	82.8	96%	55.7	36	8
Antero	PlainsGold	HWW	82.0	95%	56.3	38	7
Thunder CL	PlainsGold	HWW	81.2	95%	57.3	38	2
Average			85.9		57.0	37	5



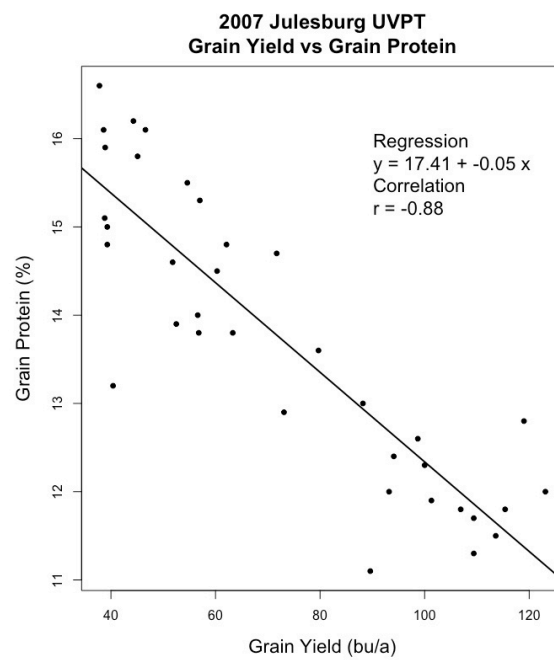
Grain Protein Issues

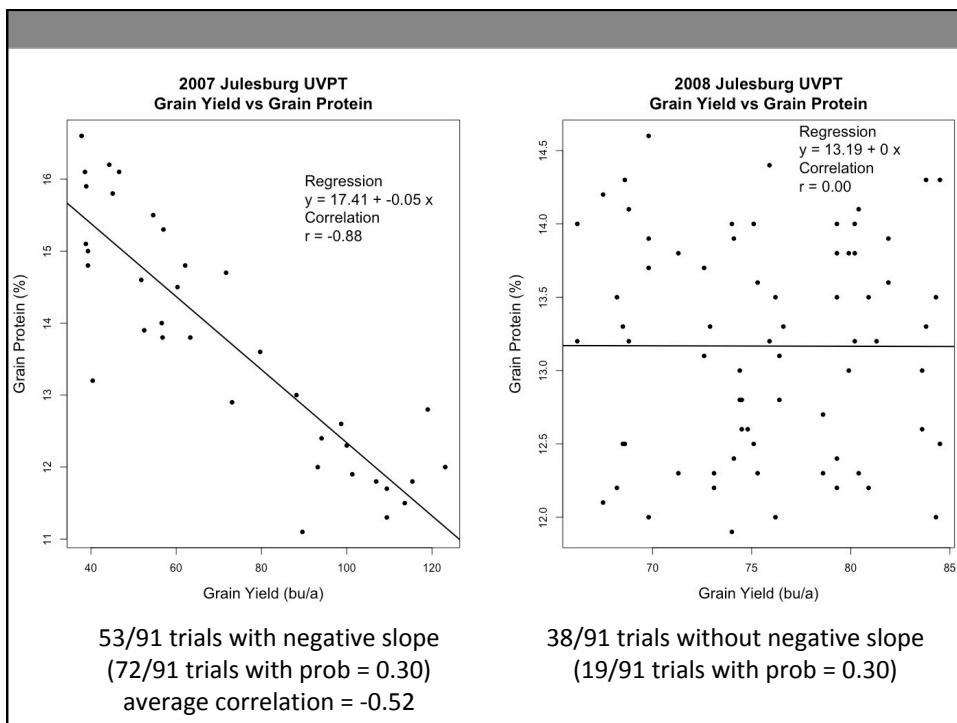
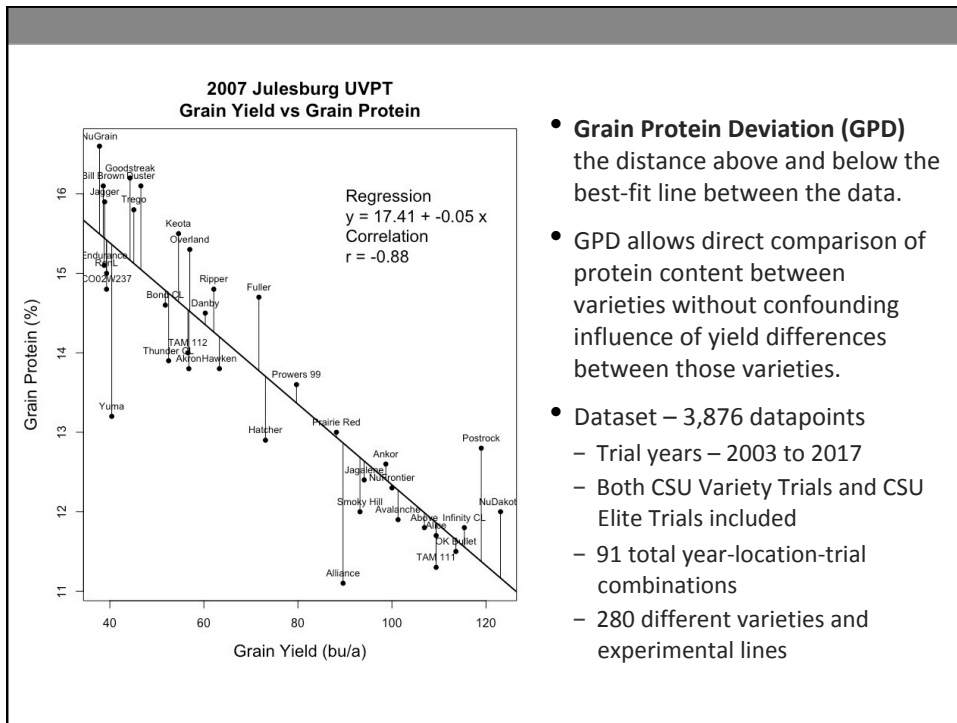
- Since 2014, winter wheat in eastern Colorado has generally received above average precipitation, resulting in higher than average grain yields.
- Unfortunately, in many areas producers have experienced low grain protein in their crop, resulting in price discounts not just here in Colorado but throughout the region.
- There are many factors involved -
 - Higher than average grain yields – CSU dryland variety trial average from 2010-13 was 47 bu/a, and from 2014-17 was 66 bu/a (<http://ramwheatdb.com>).
 - Higher grain yield of newer varieties, and in particular, higher yield potential of newer varieties compared to older varieties.



Breeding for Grain Protein?

- Due to what has been called the “dilution effect”, grain protein content and grain yield are usually inversely related.
 - Same management in the field, with some spatial variation (soil texture, application variation, organic matter, etc)
 - High yielding plots/varieties -> lower protein
 - Lower yielding plots/varieties -> higher protein
- The inverse relationship between grain protein content and grain yield is a very well known phenomenon in the scientific literature.
- Because of this, few (if any) wheat breeding programs practice selection based on grain protein with the obvious concern that this would lead to lower grain yield among the selections.
- What does this relationship look like?

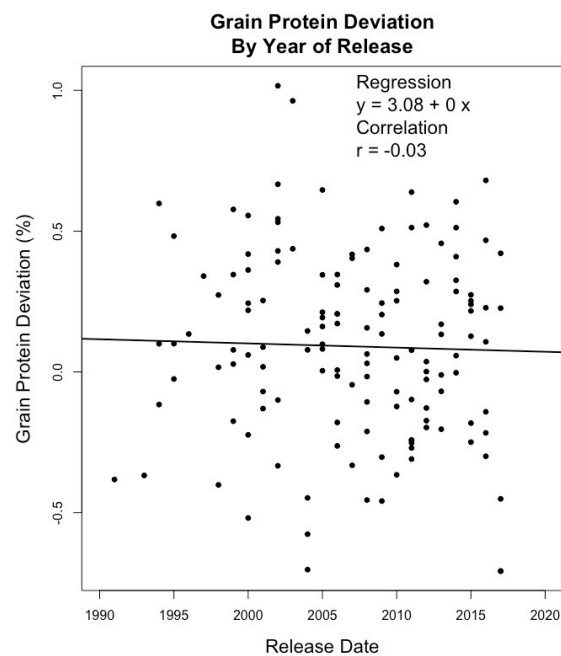




Grain Protein Deviation Scores

Higher Positive GPD	Medium GPD	Medium GPD	Higher Negative GPD
Brawl CL Plus (1)	Breck (4)	Ripper (5)	Avery (7)
WB4721 (1)	Doublestop CL Plus (4)	Settler CL (5)	Byrd (7)
Oakley CL (2)	LCS Chrome (4)	SY Monument (5)	CO13003C (7)
TAM 204 (2)	Ruth (4)	TAM 112 (5)	Cowboy (7)
WB4458 (2)	SY Sunrise (4)	Winterhawk (5)	Denali (7)
LCS Pistol (3)	SY Wolf (4)	Above (6)	Spur (7)
Sunshine (3)	T158 (4)	Akron (6)	Tatanka (7)
SY Rugged (3)	WB4303 (4)	Antero (6)	Hatcher (8)
TAM 114 (3)	Bearpaw (5)	Gallagher (6)	Incline AX (8)
WB-Cedar (3)	CO12D1770 (5)	Joe (6)	Snowmass (8)
WB4462 (3)	CO13D1299 (5)	Langin (6)	Thunder CL (8)
	KanMark (5)	LCS Mint (6)	Yuma (8)
	Larry (5)	TAM 113 (6)	LCS Fusion AX (9)
	Prairie Red (5)	WB-Grainfield (6)	

Values will be updated each year, and posted in the Variety Characteristics Table and on the searchable database at <http://ramwheatdb.com>





Breck Foundation Seed Production
Fort Collins 2017

New Varieties – Fall 2017

- Pedigree - 50% Antero, 25% Denali (Denali/HV9W07-482W//Antero)
- Higher dryland grain yield than Snowmass/Sunshine
- Higher irrigated grain yield than Thunder CL
- Very good quality, similar to Sunshine, but lower PPO
- Good stripe rust resistance (same genes as Antero)
- Excellent test weight and sprouting tolerance, good straw strength



Breck (hard white winter wheat)

New Varieties – Fall 2017



Incline AX (hard red winter wheat)

- Pedigree - 66% Byrd, 34% Hatcher (AF28/Byrd)/(AF10/2*Byrd)
- Resistance to group 1 herbicide *Aggressor* for winter annual grassy weed control (esp. rye, cheatgrass)
- Good straw strength and quality, later maturity
- Slightly lower yield, lower test weight compared to Brawl CL Plus



<http://www.coaxiumwps.com>

New Varieties – Fall 2018



CO12D1770 – HRWW
(Denali/Antero//Byrd)



CO13D1299 – HWWW
(CO07W722-F5/Snowmass//Brawl CL Plus)

Acknowledgements

