Technical Report TR12-11

Agricultural Experiment Station

Colorado State University

College of Agricultural Sciences | Department of Soil & Crop Sciences | Extension

Crops Testing

Making Better Decisions

2012 Colorado Winter Wheat Variety Performance Trials

Table of Contents

Authors

Dr. Jerry Johnson - Associate Professor and Extension Specialist - Crop Production, Colorado State University, Department of Soil and Crop Sciences, Phone: 970-491-1454, E-mail: jerry.johnson@colostate.edu.

Dr. Scott Haley - Professor and Wheat Breeder, Colorado State University, Department of Soil and Crop Sciences, Phone: 970-491-6483, E-mail: scott.haley@colostate.edu.

Sally Sauer - Research Associate - Crops Testing, Colorado State University, Department of Soil and Crop Sciences, Phone: 970-491-1914, E-mail: sally.sauer@colostate.edu.

Dr. Mike Bartolo - Superintendent and Research Scientist, Colorado State University, Arkansas Valley Research Center, 27901 Road 21, Rocky Ford, CO 81067, Phone: 719-254-6312, E-mail: michael.bartolo@colostate.edu.

Kevin Larson - Superintendent and Research Scientist, Colorado State University, Plainsman Research Center, PO Box 477, Walsh, CO 81090, Phone: 719-324-5643, E-mail: kevin.larson@colostate.edu.

Dr. Frank Peairs - Professor and Extension Specialist - Entomology, Colorado State University, Department of Bioagricultural Sciences & Pest Management, Phone: 970-491-5945, E-mail: frank.peairs@colostate.edu.

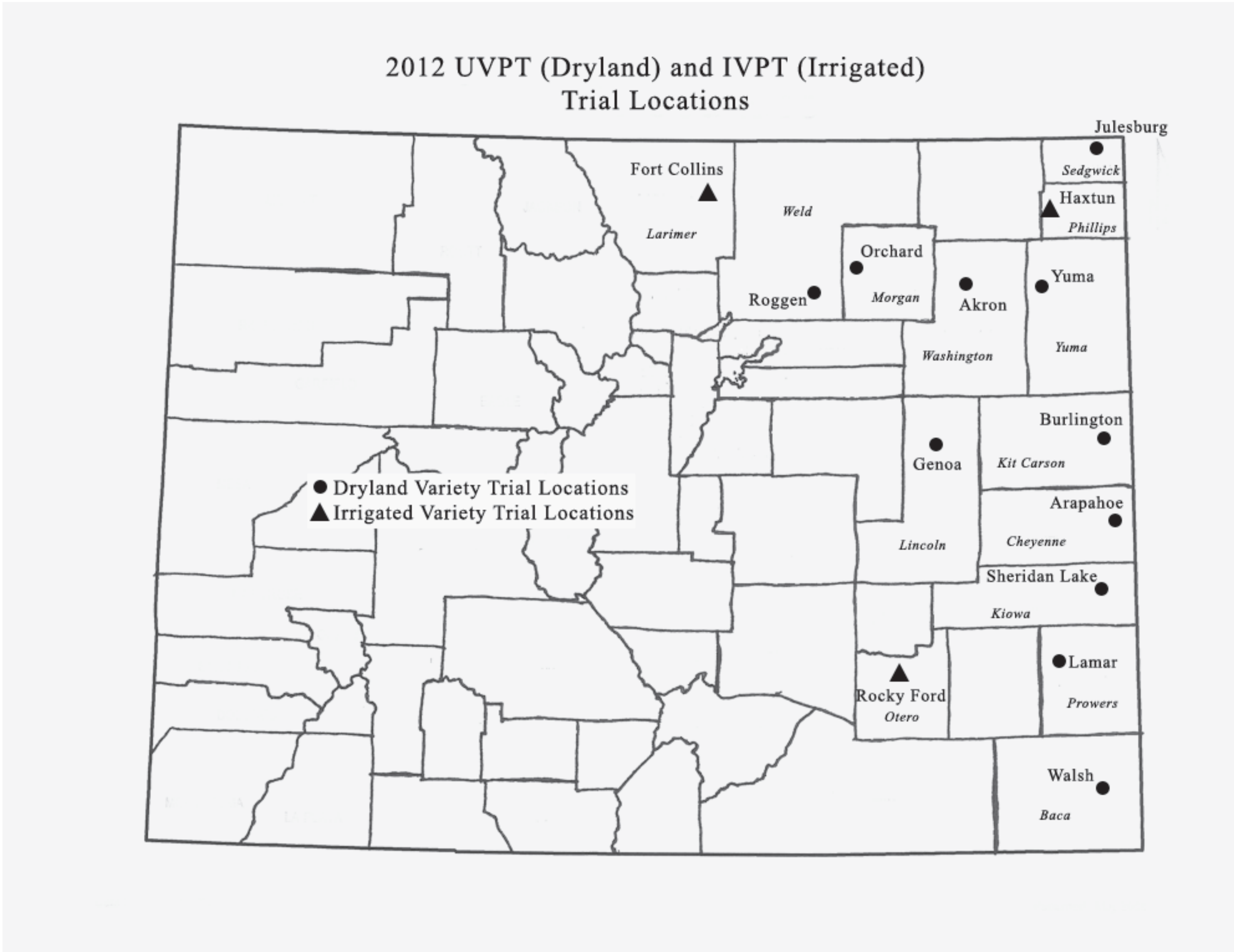
Dr. Ned Tisserat - Professor and Extension Specialist - Plant Pathology, Colorado State University, Department of Bioagricultural Sciences & Pest Management, Phone: 970-491-6527, E-mail: ned.tisserat@colostate.edu.

Dr. Phil Westra - Professor and Extension Specialist - Weed Science, Colorado State University, Department of Bioagricultural Sciences & Pest Management, Phone: 970-491-5219, E-mail: philip.westra@colostate.edu.

Dr. Jessica Davis - Professor and Extension Specialist - Soils, Colorado State University, Department of Soil and Crop Sciences, Phone: 970-491-1913, E-mail: jessica.davis@colostate.edu.

Dr. Dwayne Westfall - Professor Emeritus -Soil Fertility and Cropping Systems, Colorado State University, Department of Soil and Crop Sciences.

Glenda Mostek - Communications and Marketing Director, Colorado Wheat Administrative Committee, Colorado Association of Wheat Growers, and the Colorado Wheat Research Foundation, 4026 South Timberline Road, Suite 100, Fort Collins CO 80525, Phone: 970-449-6994, Toll free: 1-800-WHEAT-10, E-mail: gmostek@coloradowheat.org.


2012 UVPT (Dryland) and IVPT (Irrigated)
Trial Locations
Julesburg
Sedgwick
Fort Collins
Haxtun
Weld
Phillips
Larimer
Orchard
Yuma
Roggen
Akron
Morgan
Washington
Yuma
Burlington
Genoa
Kit Carson
Dryland Variety Trial Locations
Irrigated Variety Trial Locations
Arapahoe
Cheyenne
Lincoln
Sheridan Lake
Kiowa
Lamar
Rocky Ford
Prowers
Otero
Walsh
Baca

2012 Eastern Colorado Winter Wheat Variety Performance Trials

Jerry Johnson and Scott Haley

The Colorado State University Crops Testing and Wheat Breeding and Genetics programs provide current, reliable, and unbiased wheat variety information as quickly as possible to Colorado producers for making better variety decisions. CSU has an excellent research faculty and staff, a focused breeding program, graduate and undergraduate students, and dedicated agricultural extension specialists. However, wheat improvement in Colorado would not be possible without the support and cooperation of the entire Colorado wheat industry. On-going and strong producer support for our programs is critical for sustained public variety development and testing.

Our wheat variety performance trials, and Collaborative On-Farm Test (COFT), represent the final stages of a wheat breeding program where promising experimental lines are tested under an increasingly broad range of environmental conditions. As a consequence of large environmental variation, Colorado State University annually conducts a large number of performance trials and on-farm tests. These trials serve to guide producer variety decisions and to assist our breeding program to more reliably select and advance the most promising lines toward release as new varieties.

2012 Variety Performance Trials

There were excellent planting conditions at almost all dryland performance trial locations in fall 2011 resulting in good to excellent emergence and plant stands. The lone exception was Walsh which suffered from extremely dry soil conditions at planting, and poor fall stands resulted from deep planting. Low winter precipitation was received throughout eastern Colorado and all of the dryland trials suffered from spring drought except Yuma and Julesburg trials where the effects were less marked. High spring temperatures, particularly in March and April, were seen at all trial locations resulting in above average cumulative growing degree-days and accelerated plant development. For example, at Akron there were 180% of normal cumulative growing degree-days from January through May but only 49% of average precipitation for the same period. The Roggen trial suffered more than other trials from drought and high temperatures which resulted in extreme intra-plot variation preventing reliable data analysis and interpretation. Windy conditions at all locations exacerbated the effects of drought and high temperatures. Stripe rust was observed at low levels at most locations but dry conditions in May reduced disease incidence and spread. Stripe rust was most evident at Genoa, where the higher altitude and cooler temperatures favored rust development, and at Julesburg where precipitation patterns were more favorable for stripe rust infection. All trials experienced above average growing degree-days that led to very early crop development and harvest. The Sheridan Lake trial received hail in early April and the trial at Walsh was destroyed by hail prior to harvest. Brown wheat mite damage was observed at Arapahoe and insecticide was applied to control the mites. There was a significant dryland root rot infection in the Burlington trial due to very lush early spring growth and subsequent drought stress conditions.

The Irrigated Variety Performance Trials (IVPT) at Rocky Ford and Haxtun were excellent. Due to continuing problems with the irrigation system, and an abnormally dry spring, the trial at Fort Collins had inadequate moisture from jointing until heading though irrigation frequency was improved during grain filling. All three trial locations had high spring growing degree-days resulting in early trial maturity. At Rocky Ford and Haxtun, above average growing degree-days contributed to high yields though stripe rust infection adversely affected the yield potential of susceptible varieties. While fungicide was not applied at Rocky Ford, it was applied at Haxtun but the flag leaves of susceptible varieties were lost before the fungicide controlled the disease. Lodging was significant at Haxtun and varieties without good straw strength were heavily lodged. Lodging did not occur at Fort Collins and was minimal at Rocky Ford.

There were 42 entries in the dryland performance trials (UVPT) and 32 entries in the irrigated performance trials (IVPT). All trials included a combination of public and private varieties and experimental lines from Colorado, Texas, Kansas, Oklahoma, Nebraska, and Montana. All dryland and irrigated trials were planted in a randomized complete block design with three replicates. Plot size was approximately 175 ft^2 and all varieties were planted at 700,000 viable seeds per acre for dryland trials and 1.2 million viable seeds per acre for irrigated trials. Yields are corrected to 12% moisture. Test weight information was obtained from a combine equipped with a Harvest Master measuring system.

Summary of 2012 Dryland Variety Performance Results

Variety Origin[a] and Release Year	Variety[b]	Market Class[c]	Yield[d]	Yield	Test Weight[d]	Plant Height[d]
			bu/ac	% trial average	lb/bu	in
CSU/PG 2011	Byrd	HRW	54.9	114%	61.1	28
CSU exp	CO07W245	**HWW**	54.6	113%	61.7	28
CSU exp	CO07W722-F5	**HWW**	52.6	109%	60.7	25
AP exp	SY Exp. 1029	HRW	52.4	108%	59.9	27
CSU exp	CO050233-2	HRW	52.0	108%	60.4	27
CSU exp	CO08263	HRW	51.7	107%	60.8	26
TX/W 2005	TAM 112	HRW	51.6	107%	61.8	28
CSU/PG 2006	Ripper	HRW	51.0	105%	60.1	27
CSU exp	CO08W218	**HWW**	51.0	105%	62.2	27
CSU/PG 2011	Brawl CL Plus	HRW	50.9	105%	62.1	29
TX/AGSECO 2010	TAM 113	HRW	50.9	105%	61.7	29
CSU/PG 2004/2011	CSU Blend12	HRW	50.4	104%	61.3	26
LG 2009	T158	HRW	49.8	103%	61.6	28
AP 2011	SY Wolf	HRW	49.1	102%	61.5	28
TX/AP 2002	TAM 111	HRW	49.1	101%	61.3	29
TX/CSU 2001	Above	HRW	49.0	101%	60.4	26
CSU/PG 2011	Denali	HRW	48.9	101%	62.0	28
CSU exp	CO08W454	**HWW**	48.8	101%	61.1	27
LG 2010	T163	HRW	48.6	100%	61.8	28
CSU/AGSECO 2004	Protection	HRW	48.6	100%	59.3	29
WB 2007	Winterhawk	HRW	48.6	100%	61.9	28
CSU exp	CO05W111	**HWW**	48.5	100%	61.2	28
NE 2008	Settler CL	HRW	48.4	100%	61.1	26
TX/SS 2006	TAM 304	HRW	48.2	100%	59.8	27
CSU/PG 2004	Hatcher	HRW	48.2	100%	61.1	26
CSU/PG 2007	Bill Brown	HRW	48.0	99%	62.0	26
NE 2010	Robidoux	HRW	48.0	99%	61.2	28
CSU exp	CO08346	HRW	47.7	98%	62.4	27
CSU exp	CO08W328	**HWW**	47.2	98%	62.2	28
WB 2008	Armour	HRW	46.6	96%	60.7	27
CSU/PG 2008	Thunder CL	**HWW**	46.3	96%	60.6	26
CSU/PG 2004	Bond CL	HRW	46.3	96%	58.4	28
KSU exp	KS020319-7-3	HRW	46.2	95%	60.5	27
KSU 2011	Clara CL	**HWW**	46.0	95%	62.5	27
CSU/PG 2009	Snowmass	**HWW**	45.8	95%	60.8	29
NE 2010	McGill	HRW	45.8	95%	60.5	29
KSU 2009	Everest	HRW	45.6	94%	61.8	26
NE exp	NE05496	HRW	45.6	94%	60.8	26
CSU exp	CO08M011	HRW	45.5	94%	61.0	27
OK exp	OK05312	HRW	43.9	91%	61.9	27
NE exp	NE05548	HRW	43.6	90%	59.2	27
MT 2011	Judee	HRW	37.0	77%	60.5	26
		Average	**48.4**		**61.1**	**27**

[a]Variety origin codes: CSU=Colorado State University; TX/CSU=Joint release by Texas A&M and Colorado State Universities; WB=WestBred (Monsanto); AP=AgriPro (Syngenta); CSU/AGSECO=Colorado State release, marketed by AGSECO; TX/AGSECO=Texas A&M release, marketed by AGSECO; TX/W=Texas A&M release, marketed by Watley Seed Co.; TX/SS=Texas A&M release, marketed by Scott Seed Co.; CSU/PG=CSU release, marketed by CWRF under the PlainsGold brand; TX/AP=Texas A&M release, marketed by AgriPro (Syngenta); MT=Montana State University; KSU=Kansas State University; LG=Limagrain Cereal Seeds; NE=University of Nebraska; OK=Oklahoma State University.

[b]Varieties ranked according to average yield in 2012.

[c]Market class: HRW=hard red winter wheat; **HWW**=hard white winter wheat.

[d]The 2012 average yield, test weight, and plant height are based on nine 2012 trials.

Summary of 2-Year Dryland Variety Performance Results

Variety Origin[a] and Release Year	Variety[b]	Market Class[c]	2-Year Average[d] Yield	Yield	Test Weight	Plant Height
			bu/ac	% trial average	lb/bu	in
CSU/PG 2011	Byrd	HRW	55.3	113%	60.4	29
CSU exp	CO07W245	**HWW**	54.7	112%	60.7	28
CSU exp	CO050233-2	HRW	51.3	105%	59.7	28
TX/W 2005	TAM 112	HRW	51.1	104%	61.1	28
CSU/PG 2006	Ripper	HRW	50.9	104%	59.2	26
CSU/PG 2011	Denali	HRW	50.2	102%	60.9	29
CSU/PG 2004	Hatcher	HRW	50.0	102%	60.2	26
TX/CSU 2001	Above	HRW	49.3	101%	59.5	27
CSU/PG 2007	Bill Brown	HRW	49.2	101%	60.8	26
AP 2011	SY Wolf	HRW	49.2	100%	60.2	28
NE 2008	Settler CL	HRW	49.2	100%	60.0	27
CSU/PG 2011	Brawl CL Plus	HRW	48.9	100%	60.8	28
CSU exp	CO05W111	**HWW**	48.7	99%	60.1	29
WB 2007	Winterhawk	HRW	48.5	99%	60.9	29
LG 2010	T163	HRW	48.5	99%	60.3	28
CSU/PG 2009	Snowmass	**HWW**	47.6	97%	59.9	29
NE 2010	Robidoux	HRW	47.3	97%	60.1	28
CSU/PG 2008	Thunder CL	**HWW**	46.5	95%	59.5	27
WB 2008	Armour	HRW	46.4	95%	59.5	26
CSU/PG 2004	Bond CL	HRW	46.4	95%	58.0	29
OK exp	OK05312	HRW	46.0	94%	60.8	27
NE 2010	McGill	HRW	45.7	93%	59.5	29
KSU 2009	Everest	HRW	45.5	93%	60.9	26
		Average	**49.0**		**60.1**	**28**

[a]Variety origin codes: CSU=Colorado State University; TX/CSU=Joint release by Texas A&M and Colorado State Universities; WB=WestBred (Monsanto); AP=AgriPro (Syngenta); TX/W=Texas A&M release, marketed by Watley Seed Co.; KSU=Kansas State University; NE=University of Nebraska; CSU/PG=CSU release, marketed by CWRF under the PlainsGold brand; LG=Limagrain Cereal Seeds; OK=Oklahoma State University.

[b]Varieties ranked according to average 2-year yield.

[c]Market class: HRW=hard red winter wheat; **HWW**=hard white winter wheat.

[d]The 2-year average yield, test weight, and plant height are based on six 2011 trials and nine 2012 trials.

Summary of 3-Year Dryland Variety Performance Results

Variety Origin[a] and Release Year	Variety[b]	Market Class[c]	3-Year Average[d] Yield	Yield	Test Weight	Plant Height
			bu/ac	% trial average	lb/bu	in
CSU/PG 2011	Byrd	HRW	59.3	112%	60.3	30
CSU exp	CO050233-2	HRW	55.5	105%	60.0	29
CSU/PG 2011	Denali	HRW	55.2	104%	61.3	30
CSU/PG 2006	Ripper	HRW	53.9	102%	59.2	27
NE 2008	Settler CL	HRW	53.6	101%	60.3	28
CSU exp	CO05W111	**HWW**	53.5	101%	60.7	30
TX/W 2005	TAM 112	HRW	53.4	101%	60.9	29
CSU/PG 2004	Hatcher	HRW	53.3	100%	60.5	27
WB 2007	Winterhawk	HRW	53.0	100%	61.2	29
CSU/PG 2007	Bill Brown	HRW	52.9	100%	60.8	27
TX/CSU 2001	Above	HRW	52.4	99%	59.7	28
CSU/PG 2011	Brawl CL Plus	HRW	52.3	98%	61.0	29
CSU/PG 2009	Snowmass	**HWW**	51.8	98%	60.4	30
CSU/PG 2004	Bond CL	HRW	50.9	96%	58.2	30
WB 2008	Armour	HRW	50.9	96%	59.5	27
CSU/PG 2008	Thunder CL	**HWW**	50.8	96%	59.6	28
KSU 2009	Everest	HRW	49.8	94%	61.1	27
		Average	**53.1**		**60.3**	**29**

[a]Variety origin codes: CSU=Colorado State University; TX/CSU=Joint release by Texas A&M and Colorado State Universities; WB=WestBred (Monsanto); TX/W=Texas A&M release, marketed by Watley Seed Co.; KSU=Kansas State University; NE=University of Nebraska; CSU/PG=CSU release, marketed by CWRF under the PlainsGold brand.

[b]Varieties ranked according to average 3-year yield.

[c]Market class: HRW=hard red winter wheat; **HWW**=hard white winter wheat.

[d]The 3-year average yield, test weight, and plant height are based on nine 2010 trials, six 2011 trials, and nine 2012 trials.

2012 Collaborative On-Farm Test (COFT) Variety Performance Results

The objective of the 2012 COFT was to compare performance and adaptability of popular and newly released CSU varieties (Byrd, Brawl CL Plus, and Snowmass) with proven high-yielding varieties (Hatcher and Settler CL) and with a commercial variety (TAM 112) under unbiased, field-scale testing conditions. The COFT program is in its 14th year and much of Colorado's 2012 wheat acreage was planted to winter wheat varieties that have been tested in the COFT program. In the fall of 2011, thirty-five eastern Colorado wheat producers planted COFT in Baca, Bent, Prowers, Kiowa, Cheyenne, Kit Carson, Washington, Yuma, Phillips, Sedgwick, Lincoln, Logan, Adams, and Weld counties. Each collaborator planted the six varieties in side-by-side strips (approximately 1.25 acres per variety) at the same seeding rate as they seeded their own wheat. Thirty-one viable harvest results were obtained from the thirty-five tests. The COFT results need to be interpreted based on all tests within a year and not on the basis of a single variety comparison on a single farm in one year. In addition to the overall 2012 COFT variety performance results, we have added a summary table of this year's COFT results grouped by geographic region to assist with variety comparisons.

Colorado extension wheat educators who conducted the COFT program in 2012

Dr. Jerry Johnson – Extension Specialist-Crop Production, Fort Collins
Bruce Bosley – Extension Agronomist, Logan County
Dr. Wilma Trujillo – Extension Agronomist, Prowers County
Alan Helm – Extension Agronomist, Phillips County (no longer in CSU Extension)
Ron Meyer – Extension Agronomist, Golden Plains Area

2012 Collaborative On-Farm Test (COFT) Variety Performance Results

	2012 Varieties[a]												COFT Average	
	Byrd		Brawl CL Plus		Hatcher		Settler CL		TAM 112		Snowmass			
County/Nearest Town	Yield[b]	Test Weight	Yield[b]	Test Weight	Yield[b]	Test Weight	Yield[b]	Test Weight	Yield[b]	Test Weight	Yield[b]	Test Weight	Yield[b]	Test Weight
	bu/ac	lb/bu	bu/ac	lb/bu	bu/ac	lb/bu	bu/ac	lb/bu	bu/ac	lb/bu	bu/ac	lb/bu	bu/ac	lb/bu
Adams/Bennett	52.7	58.2	45.3	59.2	50.2	60.8	43.1	60.2	45.9	62.5	43.0	60.8	*46.7*	*60.3*
Adams/Last Chance	15.0	58.0	16.0	60.5	11.4	60.0	13.0	58.5	15.2	61.0	11.5	59.5	*13.7*	*59.6*
Baca/Two Buttes	9.3	57.7	13.5	57.6	7.0	60.0	10.2	56.6	11.0	58.8	6.5	58.7	*9.6*	*58.2*
Baca/Vilas	34.3	59.4	39.6	61.0	31.9	58.6	37.1	59.1	36.3	60.6	30.2	58.0	*34.9*	*59.5*
Bent/Lamar W	34.5	59.5	32.3	60.4	30.5	59.9	30.7	58.9	32.0	60.4	29.5	59.2	*31.6*	*59.7*
Cheyenne/Arapahoe	42.1	61.2	41.7	60.1	34.2	59.6	50.4	59.2	34.5	61.4	37.4	60.5	*40.1*	*60.3*
Cheyenne/Cheyenne Wells	32.3	59.6	28.2	60.4	31.6	62.0	29.8	59.0	29.6	60.8	29.6	58.7	*30.2*	*60.1*
Kiowa/Haswell	16.3	61.2	15.6	62.7	15.2	62.7	13.0	61.0	14.2	61.9	10.8	60.5	*14.2*	*61.7*
Kiowa/Towner	22.3	59.2	22.3	60.9	21.9	59.1	22.7	59.4	20.6	59.6	20.7	60.9	*21.8*	*59.9*
Kit Carson/Bethune	57.5	61.4	54.2	61.8	54.7	64.6	46.4	55.8	49.4	61.1	51.3	62.2	*52.3*	*61.2*
Kit Carson/Stratton	50.0	56.1	48.0	58.7	49.9	59.5	48.0	58.7	50.7	57.8	41.8	56.5	*48.1*	*57.9*
Lincoln/Arriba	64.9	62.0	60.2	65.5	62.1	63.0	58.0	63.0	59.0	62.5	56.7	62.5	*60.2*	*63.1*
Lincoln/Thurman	66.9	60.4	65.4	62.3	64.6	61.6	64.4	60.7	59.4	62.9	54.1	60.2	*62.5*	*61.4*
Logan/Leroy	56.7	60.5	53.4	61.5	50.5	60.5	50.7	61.0	53.1	59.0	49.0	60.0	*52.2*	*60.4*
Logan/Peetz	37.9	62.0	32.6	64.5	38.1	62.0	39.2	62.5	31.8	64.0	35.8	63.0	*35.9*	*63.0*
Logan/Sterling W	49.8	60.5	46.9	61.0	41.3	60.5	41.0	58.0	34.5	61.5	38.9	59.0	*42.1*	*60.1*
Phillips/Haxtun	40.7	54.8	43.5	58.0	44.1	57.5	43.2	55.5	40.1	56.2	33.2	53.4	*40.8*	*55.9*
Prowers/Bristol	49.2	59.0	40.0	57.9	41.0	58.9	39.2	55.4	48.5	60.9	42.4	56.9	*43.4*	*58.2*
Prowers/Lamar S	53.1	62.2	48.6	62.0	47.5	61.5	45.8	59.8	45.0	60.3	46.2	60.1	*47.7*	*61.0*
Prowers/Two Buttes N	17.2	56.0	16.5	58.0	13.8	55.0	16.5	54.0	17.0	57.0	13.8	55.0	*15.8*	*55.8*
Washington/Akron S	25.6	59.0	29.0	61.0	26.1	60.0	26.7	60.5	27.5	61.0	24.1	59.0	*26.5*	*60.1*
Washington/Akron W	33.5	59.1	33.4	60.2	35.5	60.0	32.6	60.4	32.3	58.5	28.7	58.0	*32.7*	*59.4*
Washington/Anton	10.4	58.0	9.6	59.0	9.6	59.0	10.7	57.5	9.2	58.0	9.4	59.0	*9.8*	*58.4*
Washington/Otis	58.3	61.5	57.6	61.5	52.0	61.0	49.0	61.5	49.0	63.0	45.6	61.0	*51.9*	*61.6*
Washington/Platner	52.9	60.0	53.9	62.5	52.5	61.5	47.5	61.0	47.3	60.5	46.9	60.0	*50.2*	*60.9*
Washington/Woodlin	39.6	58.5	38.5	60.0	39.9	59.5	36.6	59.0	36.7	60.5	32.5	58.5	*37.3*	*59.3*
Washington/Woodrow	53.2	62.0	49.4	62.5	49.9	63.5	49.4	62.5	47.6	62.0	43.7	63.5	*48.9*	*62.7*
Weld/Keenesburg	68.9	59.0	68.5	60.5	68.1	61.0	72.2	61.0	67.1	61.5	64.7	60.5	*68.2*	*60.6*
Weld/New Raymer	48.6	62.0	45.3	65.5	43.5	63.0	42.1	63.0	41.3	62.5	39.9	62.5	*43.4*	*63.1*
Weld/Prospect Valley	64.9	62.0	58.5	63.5	58.9	63.0	59.4	61.0	52.8	63.0	57.4	63.0	*58.7*	*62.6*
Yuma/Yuma	52.6	60.6	48.1	61.3	50.3	60.8	49.3	60.4	49.7	60.4	46.5	59.7	*49.4*	*60.5*
Average	**42.3**	**59.7**	**40.5**	**61.0**	**39.6**	**60.6**	**39.3**	**59.5**	**38.3**	**60.7**	**36.2**	**59.7**	**39.4**	**60.2**
Significance[c] yield	A		B		C		C		D		E			

LSD $_{(0.30)}$ for yield = 0.7 bu/ac

LSD $_{(0.30)}$ for test weight = 0.3 lb/bu

[a]Varieties are ranked left to right by highest average yield.

[b]Yield corrected to 12% moisture.

[c]Significance: Varieties with different letters are significantly different from one another.

2012 Collaborative On-Farm Test (COFT) Variety Performance Comparisons

2012 Overall (31)[a]			Trial Regions: Southeast (10)[a]			Northeast (11)[a]			West (10)[a]		
Variety[b]	Yield[c]	Test Weight	Variety[b]	Yield[c]	Test Weight	Variety[b]	Yield[c]	Test Weight	Variety[b]	Yield[c]	Test Weight
	bu/ac	lb/bu		bu/ac	lb/bu		bu/ac	lb/bu		bu/ac	lb/bu
Byrd	42.4	59.7	Byrd	31.1	59.5	Byrd	49.1	59.7	Byrd	46.4	59.9
Brawl CL Plus	40.6	61.0	Brawl CL Plus	29.8	60.1	Brawl CL Plus	47.4	61.2	Hatcher	43.9	61.1
Hatcher	39.7	60.6	Settler CL	29.5	58.2	Hatcher	47.0	61.0	Brawl CL Plus	43.9	61.7
Settler CL	39.4	59.5	TAM 112	28.9	60.2	Settler CL	45.4	59.7	Settler CL	42.7	60.5
TAM 112	38.5	60.7	Hatcher	27.5	59.7	TAM 112	45.3	60.4	TAM 112	40.5	61.6
Snowmass	36.3	59.7	Snowmass	26.7	58.9	Snowmass	41.7	59.7	Snowmass	39.9	60.5
Average	**39.5**	**60.2**		**28.9**	**59.4**		**46.0**	**60.3**		**42.9**	**60.9**
$LSD_{(0.30)}$	0.7	0.3		1.3	0.4		1.1	0.5		1.2	0.4

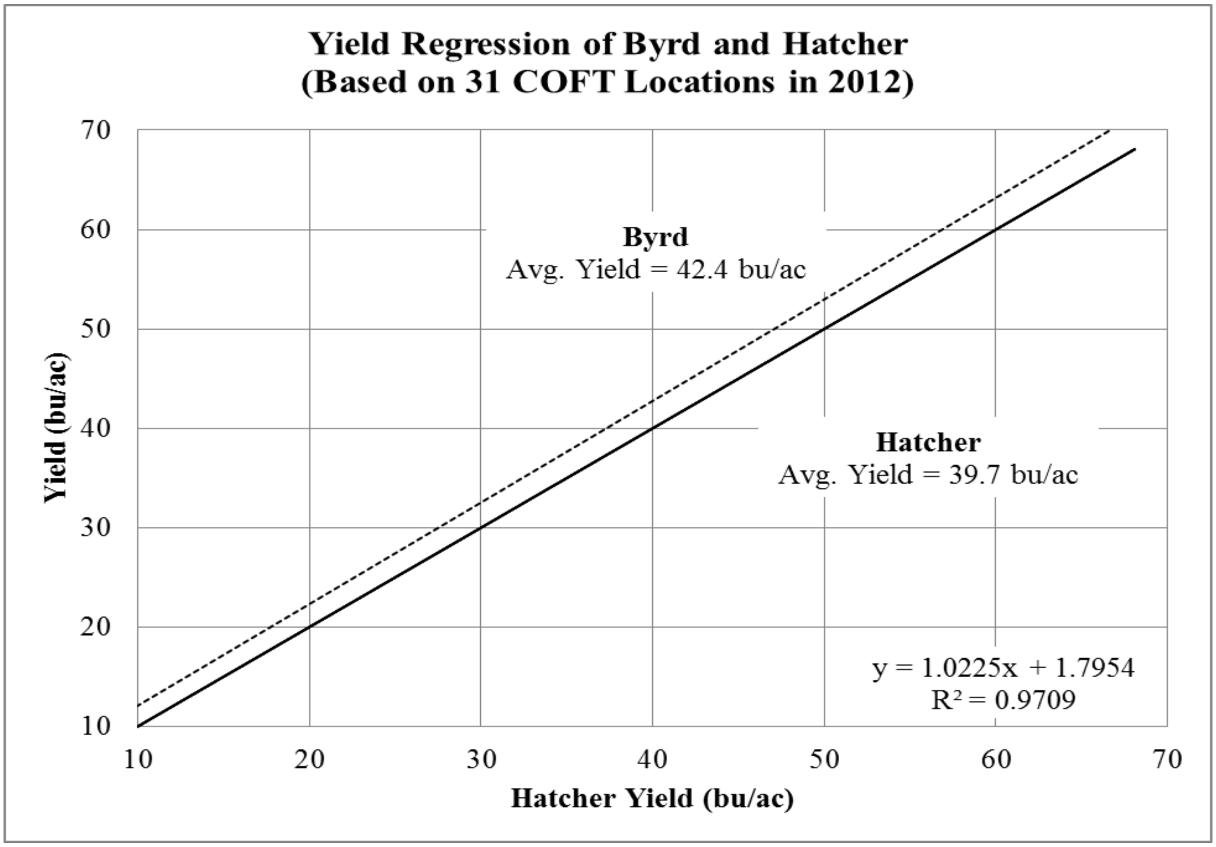
[a]Number of locations included.

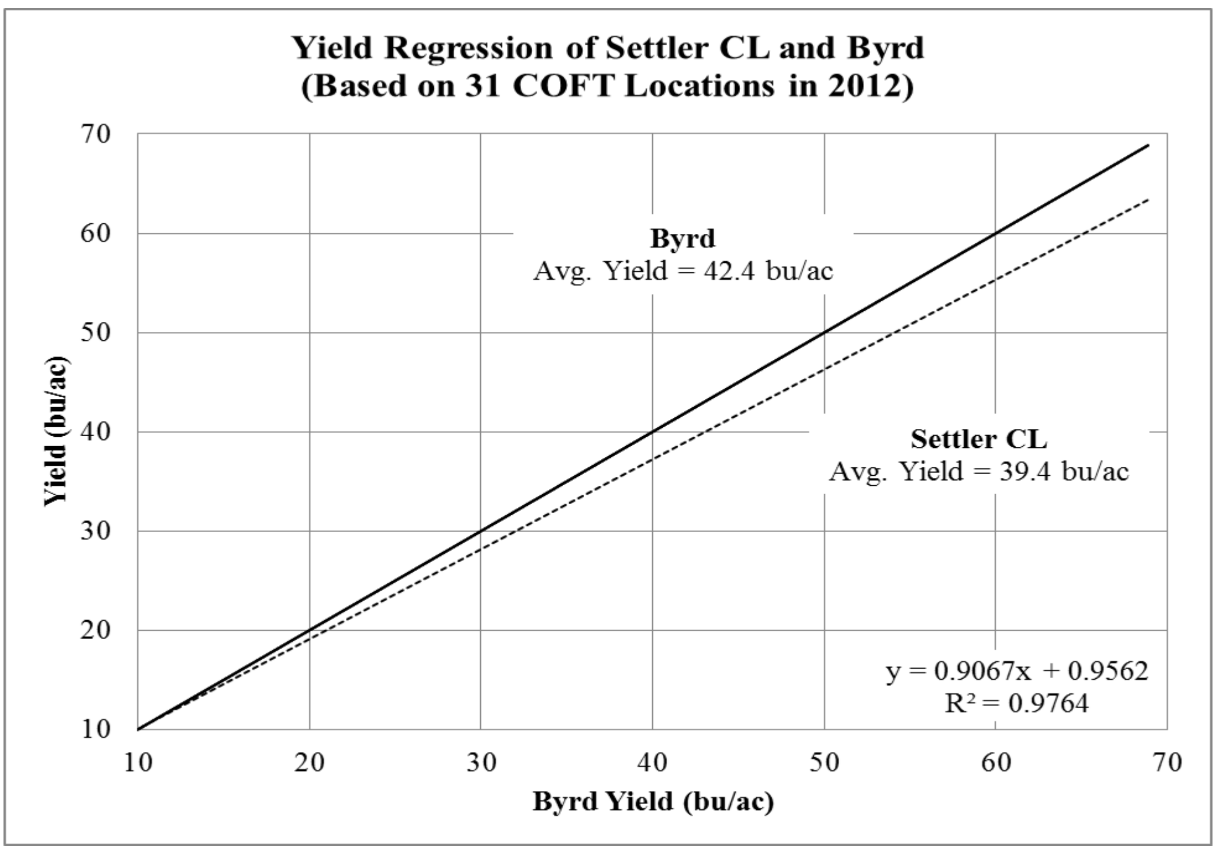
[b]Varieties are ranked by the highest average yield.

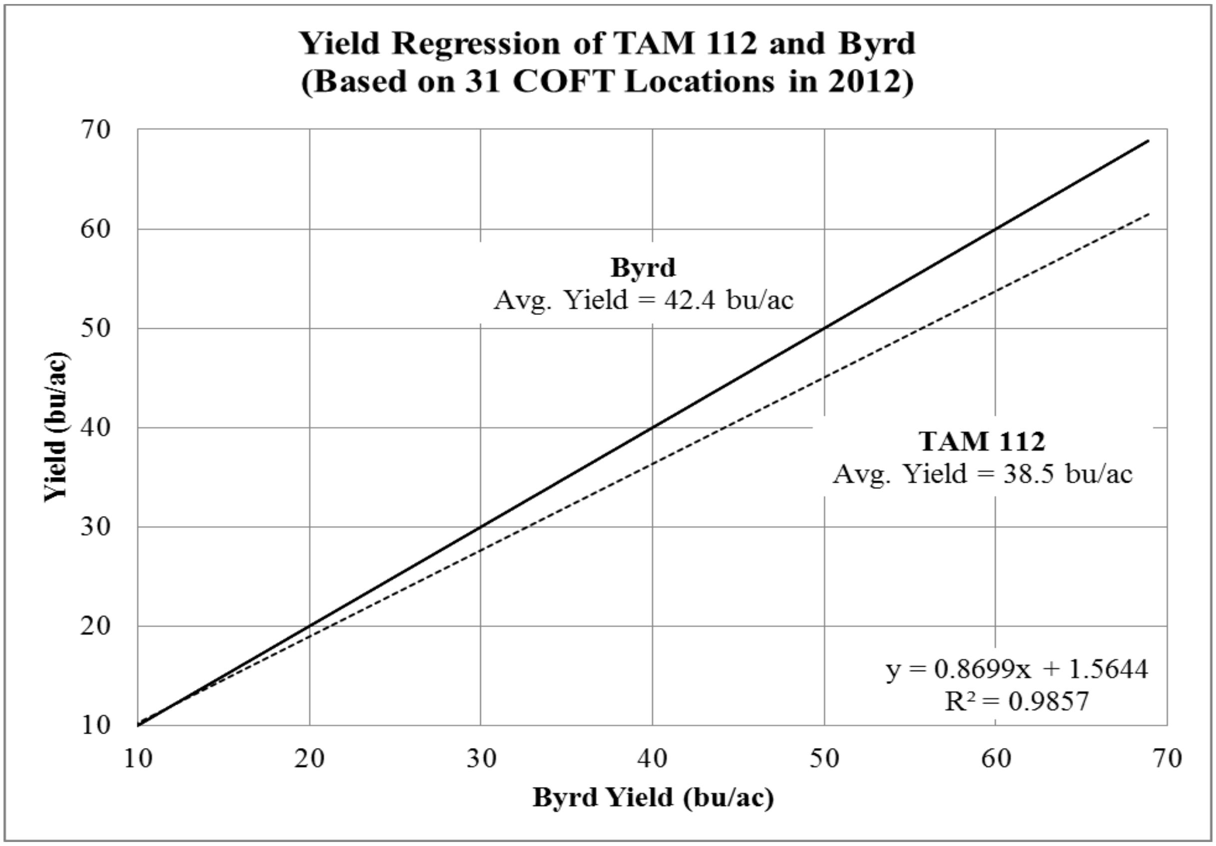
[c]Yield corrected to 12% moisture.

Yield Regressions to Compare Expected Performance of Varieties

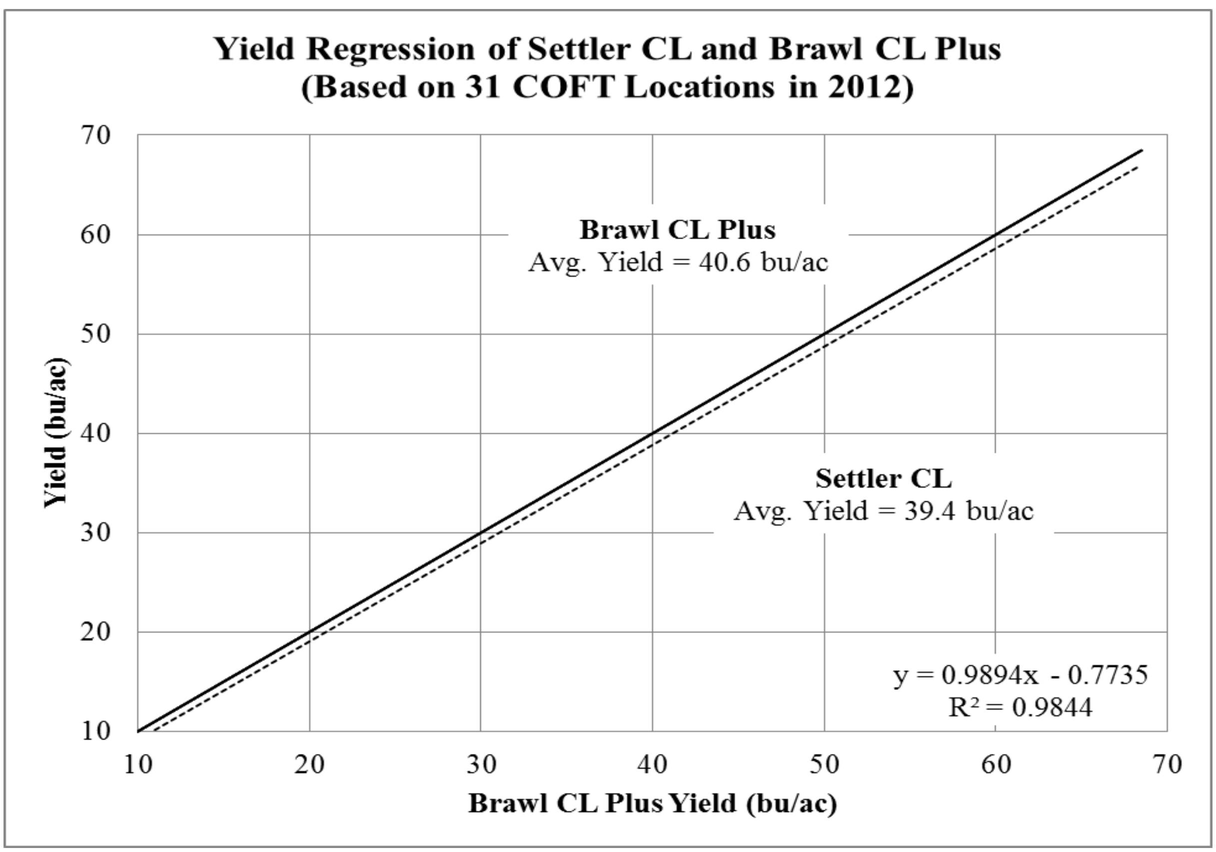
The following linear regressions are based on 31 Collaborative On-Farm Test results in 2012. They can be used as a tool to help growers visualize the expected performance of each variety in low to high-yielding environments. In the event that the lines cross over one another, the yield at the point of intersection is where we would expect one variety to be superior to another. Byrd is the variety of most interest this year. Farmers can predict the yield of three other varieties given the yield of Byrd, which is shown on the first three regressions. The fourth regression can be used to predict the yield of Settler CL given the yield of Brawl CL Plus. The equation shown in the bottom right of each graph can be used to predict the expected yield of a variety, given a yield of the variety listed on the bottom (x-axis) of the graph. For example, in the first regression, the expected yield of Byrd = 1.0225x *(yield of Hatcher) + 1.7954 bu/ac. If the yield of Hatcher is 50 bu/ac then you would expect the yield of Byrd to be 52.9 bu/ac. The R^2 value of the regression is a statistical measure that represents how well a regression line fits the actual data points. R-squared values equal to 1.0 means the regression line fits the data perfectly. It is important to point out that the comparisons are expected to be more reliable when they include more results over multiple locations from different years. Additional testing of varieties might change the relationships portrayed in the following graphs.


Yield Regression of Byrd and Hatcher
(Based on 31 COFT Locations in 2012)
Byrd
Avg. Yield = 42.4 bu/ac
Hatcher
Avg. Yield = 39.7 bu/ac
y = 1.0225x + 1.7954
R² = 0.9709
Yield (bu/ac)
Hatcher Yield (bu/ac)
10
20
30
40
50
60
70


Yield Regression of Settler CL and Byrd
(Based on 31 COFT Locations in 2012)
Byrd
Avg. Yield = 42.4 bu/ac
Settler CL
Avg. Yield = 39.4 bu/ac
y = 0.9067x + 0.9562
R² = 0.9764
Yield (bu/ac)
Byrd Yield (bu/ac)
10
20
30
40
50
60
70



Yield Regression of TAM 112 and Byrd
(Based on 31 COFT Locations in 2012)
Byrd
Avg. Yield = 42.4 bu/ac
TAM 112
Avg. Yield = 38.5 bu/ac
y = 0.8699x + 1.5644
R² = 0.9857
Yield (bu/ac)
Byrd Yield (bu/ac)
10
20
30
40
50
60
70



Yield Regression of Settler CL and Brawl CL Plus
(Based on 31 COFT Locations in 2012)
Brawl CL Plus
Avg. Yield = 40.6 bu/ac
Settler CL
Avg. Yield = 39.4 bu/ac
y = 0.9894x - 0.7735
R² = 0.9844
Yield (bu/ac)
Brawl CL Plus Yield (bu/ac)
10
20
30
40
50
60
70

Summary of 2-Year Irrigated Variety Performance Results at Fort Collins

Variety Origin[a] and Release Year	Variety[b]	Market Class[c]	2-Year Average Yield	Yield	Test Weight	Plant Height	Heading	Lodging[d]
			bu/ac	% trial average	lb/bu	in	days from trial average	scale (1-9)[e]
CSU/PG 2011	Byrd	HRW	89.7	113%	59.1	37	-1	3
CSU exp	CO050233-2	HRW	88.3	111%	58.0	37	1	1
NE 2010	Robidoux	HRW	87.8	110%	59.7	37	1	3
CSU/PG 2006	Ripper	HRW	86.0	108%	58.0	37	-1	3
AP 2011	SY Wolf	HRW	84.2	106%	58.5	38	4	2
CSU/PG 2004	Hatcher	HRW	83.0	104%	58.3	36	0	2
NE 2008	Settler CL	HRW	82.2	103%	58.9	36	1	2
AP 2010	SY Gold	HRW	81.5	103%	58.8	37	-2	1
CSU/PG 2011	Denali	HRW	80.5	101%	59.7	37	3	2
CSU exp	CO05W111	**HWW**	80.3	101%	59.8	39	3	1
WB 2008	Armour	HRW	78.7	99%	58.2	35	-3	2
CSU/PG 2004	Bond CL	HRW	77.2	97%	56.8	37	-3	2
OK 2009	Billings	HRW	76.7	96%	58.9	37	0	1
CSU/PG 1991	Yuma	HRW	75.1	95%	57.8	36	-1	2
CSU/PG 2011	Brawl CL Plus	HRW	74.4	94%	59.0	38	-3	1
NE 2010	McGill	HRW	74.0	93%	58.1	38	1	1
CSU/PG 2008	Thunder CL	**HWW**	71.7	90%	58.8	35	0	1
WB 2010	WB-Cedar	HRW	59.6	75%	57.4	35	-5	1
		Average	**79.5**		**58.5**	**37**		**2**

[a]Variety origin codes: CSU=Colorado State University; WB=WestBred (Monsanto); AP=AgriPro (Syngenta); CSU/PG=CSU release, marketed by CWRF under the PlainsGold brand; NE=University of Nebraska; OK=Oklahoma State University.

[b]Varieties ranked according to average 2-year yield at Fort Collins.

[c]Market class: HRW=hard red winter wheat; **HWW**=hard white winter wheat.

[d]Lodging scores based on 2011 trial data.

[e]Lodging scale: 1=no lodging, 9=severe lodging.

Summary of 3-Year Irrigated Variety Performance Results at Fort Collins

Variety Origin[a] and Release Year	Variety[b]	Market Class[c]	3-Year Average Yield	Yield	Test Weight	Plant Height	Heading	Lodging[d]
			bu/ac	% trial average	lb/bu	in	days from trial average	scale (1-9)[e]
CSU/PG 2011	Byrd	HRW	99.0	111%	60.4	37	0	3
CSU exp	CO050233-2	HRW	96.0	108%	59.1	37	1	1
CSU/PG 2006	Ripper	HRW	92.3	104%	59.1	36	-1	3
CSU/PG 2004	Hatcher	HRW	92.1	104%	59.8	36	0	2
NE 2008	Settler CL	HRW	90.6	102%	60.1	36	1	2
CSU/PG 2011	Denali	HRW	90.3	101%	61.4	37	2	2
WB 2008	Armour	HRW	88.4	99%	59.6	34	-3	2
CSU exp	CO05W111	**HWW**	87.2	98%	60.9	38	3	1
CSU/PG 2004	Bond CL	HRW	86.9	98%	58.2	37	-2	2
CSU/PG 2011	Brawl CL Plus	HRW	86.1	97%	60.5	37	-3	1
AP 2010	SY Gold	HRW	86.0	97%	60.2	36	-1	1
OK 2009	Billings	HRW	84.6	95%	60.2	37	0	1
CSU/PG 2008	Thunder CL	**HWW**	83.4	94%	60.2	35	0	1
CSU/PG 1991	Yuma	HRW	82.6	93%	59.2	34	-1	2
		Average	**89.0**		**59.9**	**36**		**2**

[a]Variety origin codes: CSU=Colorado State University; WB=WestBred (Monsanto); AP=AgriPro (Syngenta); CSU/PG=CSU release, marketed by CWRF under the PlainsGold brand; NE=University of Nebraska; OK=Oklahoma State University.

[b]Varieties ranked according to average 3-year yield at Fort Collins.

[c]Market class: HRW=hard red winter wheat; **HWW**=hard white winter wheat.

[d]Lodging scores based on 2011 trial data.

[e]Lodging scale: 1=no lodging, 9=severe lodging.

Summary of 2-Year Irrigated Variety Performance Results at Haxtun

			2-Year Average				
Variety Origin[a] and Release Year	Variety[b]	Market Class[c]	Yield	Yield	Test Weight	Plant Height	Lodging
			bu/ac	% trial average	lb/bu	in	scale (1-9)[d]
CSU exp	CO050233-2	HRW	133.5	108%	61.2	39	2
AP 2011	SY Wolf	HRW	129.2	105%	61.2	37	3
WB 2008	Armour	HRW	128.9	105%	61.6	35	3
OK 2009	Billings	HRW	127.9	104%	61.9	43	6
CSU/PG 2011	Brawl CL Plus	HRW	127.7	104%	62.2	39	2
WB 2010	WB-Cedar	HRW	127.0	103%	60.7	36	2
AP 2010	SY Gold	HRW	125.1	102%	61.4	39	3
CSU/PG 2011	Byrd	HRW	124.3	101%	62.7	41	5
CSU/PG 2008	Thunder CL	**HWW**	122.5	100%	62.6	37	4
CSU/PG 2004	Bond CL	HRW	120.8	98%	60.4	41	4
CSU exp	CO05W111	**HWW**	120.5	98%	61.3	41	3
CSU/PG 1991	Yuma	HRW	120.5	98%	61.7	40	4
NE 2008	Settler CL	HRW	120.2	98%	61.3	40	4
NE 2010	McGill	HRW	120.0	97%	60.0	42	6
CSU/PG 2011	Denali	HRW	119.8	97%	61.8	41	5
CSU/PG 2006	Ripper	HRW	116.5	95%	60.2	38	3
CSU/PG 2004	Hatcher	HRW	115.9	94%	61.7	40	6
NE 2010	Robidoux	HRW	115.3	94%	62.2	41	5
		Average	**123.1**		**61.4**	**39**	**4**

[a]Variety origin codes: CSU=Colorado State University; WB=WestBred (Monsanto); CSU/PG=CSU release, marketed by CWRF under the PlainsGold brand; AP=AgriPro (Syngenta); NE=University of Nebraska; OK=Oklahoma State University.

[b]Varieties ranked according to average 2-year yield at Haxtun.

[c]Market class: HRW=hard red winter wheat; **HWW**=hard white winter wheat.

[d]Lodging scale: 1=no lodging, 9=severe lodging.

Summary of 3-Year Irrigated Variety Performance Results at Haxtun

Variety Origin[a] and Release Year	Variety[b]	Market Class[c]	3-Year Average Yield	Yield	Test Weight	Plant Height	Lodging[d]
			bu/ac	% trial average	lb/bu	in	scale (1-9)[e]
CSU exp	CO050233-2	HRW	119.0	105%	61.6	36	2
WB 2008	Armour	HRW	117.1	103%	62.0	32	3
CSU/PG 2011	Brawl CL Plus	HRW	117.0	103%	62.8	36	2
CSU/PG 2011	Byrd	HRW	117.0	103%	63.2	37	5
OK 2009	Billings	HRW	116.3	103%	62.2	39	6
AP 2010	SY Gold	HRW	114.8	101%	61.0	36	3
NE 2008	Settler CL	HRW	113.3	100%	61.6	37	4
CSU/PG 2011	Denali	HRW	112.1	99%	61.6	38	5
CSU/PG 2004	Bond CL	HRW	111.9	99%	61.2	38	4
CSU exp	CO05W111	**HWW**	111.6	99%	61.6	39	3
CSU/PG 2008	Thunder CL	**HWW**	111.4	98%	62.1	35	4
CSU/PG 1991	Yuma	HRW	110.5	98%	61.5	36	4
CSU/PG 2006	Ripper	HRW	107.4	95%	60.3	35	3
CSU/PG 2004	Hatcher	HRW	105.6	93%	61.7	36	6
		Average	**113.2**		**61.7**	**36**	**4**

[a]Variety origin codes: CSU=Colorado State University; WB=WestBred (Monsanto); CSU/PG=CSU release, marketed by CWRF under the PlainsGold brand; AP=AgriPro (Syngenta); NE=University of Nebraska; OK=Oklahoma State University.

[b]Varieties ranked according to average 3-year yield at Haxtun.

[c]Market class: HRW=hard red winter wheat; **HWW**=hard white winter wheat.

[d]Lodging scores based on average of 2011 and 2012 trial data.

[e]Lodging scale: 1=no lodging, 9=severe lodging.

Summary of 2-Year Irrigated Variety Performance Results at Rocky Ford

Variety Origin[a] and Release Year	Variety[b]	Market Class[c]	2-Year Average Yield	2-Year Average Yield	2-Year Average Test Weight	2-Year Average Plant Height	Lodging[d]
			bu/ac	% trial average	lb/bu	in	scale (1-9)[e]
CSU exp	CO05W111	**HWW**	119.0	113%	60.1	40	4
CSU/PG 2011	Byrd	HRW	117.2	111%	60.7	37	4
CSU exp	CO050233-2	HRW	115.7	109%	59.6	37	1
NE 2010	Robidoux	HRW	113.4	107%	61.7	38	3
NE 2008	Settler CL	HRW	113.0	107%	59.4	37	3
CSU/PG 2006	Ripper	HRW	112.3	106%	59.1	35	2
CSU/PG 2004	Bond CL	HRW	110.6	105%	58.5	38	2
CSU/PG 2011	Denali	HRW	110.1	104%	59.8	38	3
WB 2008	Armour	HRW	105.4	100%	61.3	32	1
OK 2009	Billings	HRW	104.9	99%	60.5	35	1
WB 2010	WB-Cedar	HRW	102.3	97%	61.0	30	1
NE 2010	McGill	HRW	102.2	97%	60.4	42	4
CSU/PG 2008	Thunder CL	**HWW**	101.2	96%	61.3	36	2
CSU/PG 2004	Hatcher	HRW	99.9	95%	60.1	37	4
CSU/PG 2011	Brawl CL Plus	HRW	98.9	94%	60.1	35	1
AP 2011	SY Wolf	HRW	94.9	90%	58.7	36	3
CSU/PG 1991	Yuma	HRW	92.7	88%	58.2	36	2
AP 2010	SY Gold	HRW	88.6	84%	59.5	37	2
		Average	**105.7**		**60.0**	**36**	**2**

[a]Variety origin codes: CSU=Colorado State University; WB=WestBred (Monsanto); CSU/PG=CSU release, marketed by CWRF under the PlainsGold brand; AP=AgriPro (Syngenta); NE=University of Nebraska; OK=Oklahoma State University.

[b]Varieties ranked according to average 2-year yield at Rocky Ford.

[c]Market class: HRW=hard red winter wheat; **HWW**=hard white winter wheat.

[d]Lodging scores based on 2011 trial data.

[e]Lodging scale: 1=no lodging, 9=severe lodging.

Summary of 3-Year Irrigated Variety Performance Results at Rocky Ford

Variety Origin[a] and Release Year	Variety[b]	Market Class[c]	3-Year Average Yield	3-Year Average Yield	3-Year Average Test Weight	3-Year Average Plant Height	Lodging[d]
			bu/ac	% trial average	lb/bu	in	scale (1-9)[e]
CSU exp	CO050233-2	HRW	97.9	109%	58.9	37	1
CSU/PG 2011	Byrd	HRW	97.2	108%	59.9	38	6
CSU exp	CO05W111	**HWW**	96.2	107%	59.5	40	3
NE 2008	Settler CL	HRW	95.7	106%	58.7	38	3
CSU/PG 2006	Ripper	HRW	93.6	104%	58.1	36	4
CSU/PG 2004	Bond CL	HRW	93.4	104%	58.2	38	2
CSU/PG 2011	Denali	HRW	92.7	103%	59.6	38	3
WB 2008	Armour	HRW	90.1	100%	59.9	33	4
OK 2009	Billings	HRW	89.7	100%	60.2	36	3
CSU/PG 2008	Thunder CL	**HWW**	87.2	97%	59.7	38	2
CSU/PG 2011	Brawl CL Plus	HRW	86.0	96%	60.0	37	1
CSU/PG 2004	Hatcher	HRW	81.6	91%	59.2	37	4
CSU/PG 1991	Yuma	HRW	80.9	90%	57.8	37	2
AP 2010	SY Gold	HRW	78.7	87%	58.9	38	3
		Average	**90.1**		**59.2**	**37**	**3**

[a]Variety origin codes: CSU=Colorado State University; WB=WestBred (Monsanto); CSU/PG=CSU release, marketed by CWRF under the PlainsGold brand; AP=AgriPro (Syngenta); NE=University of Nebraska; OK=Oklahoma State University.

[b]Varieties ranked according to average 3-year yield at Rocky Ford.

[c]Market class: HRW=hard red winter wheat; **HWW**=hard white winter wheat.

[d]Lodging scores based on average of 2010 and 2011 trial data.

[e]Lodging scale: 1=no lodging, 9=severe lodging.

Winter Wheat Variety Selection in Colorado for Fall 2012 Planting

Our variety performance summary tables are intended to provide useful information to farmers, seed producers, and wheat industry representatives in Colorado and surrounding states. Variety selection and planting should be based on some general guidelines.

- Producers should focus on multiple-year yield summary results when selecting a new variety. Over time, the best buffer against making poor variety decisions has been to select varieties based on three-year average performance and not on performance in a single year.

- Producers should consider planting more than one variety based on different maturity, plant height, disease or insect resistance, test weight, lodging, herbicide tolerance, coleoptile length, or end-use quality characteristics. These non-yield traits are useful to spread your risk due to the unpredictability of weather conditions and pest problems. Refer to the *Description of Winter Wheat Varieties in Eastern Colorado Trials* for variety-specific information on RWA, heading date, height, straw strength, coleoptile length, stripe rust, leaf rust, wheat streak mosaic virus, test weight, as well as milling and baking quality (pages 24-28).

- Producers should control volunteer wheat and weeds to avoid the negative effects of a green bridge that could lead to serious virus disease infections vectored by the wheat curl mite (wheat streak mosaic virus, High Plains virus, Triticum mosaic virus) or aphids (barley yellow dwarf virus).

- Producers should soil sample to determine optimum fertilizer application rates. Sampling should be done prior to planting so nitrogen and phosphorus fertilizer requirements can be met. The CSU Extension factsheet entitled *Fertilizing Winter Wheat* is included in this report on pages 41-44 for assistance with wheat fertilization.

- Producers should be aware that new races of stripe rust emerged in 2010 and again in 2012 and many varieties that were resistant before are now susceptible. Farmers should refer to the *Description of Winter Wheat Varieties in Eastern Colorado Trials* (pages 24 – 28) for updated information on variety susceptibility. If variety resistance/susceptibility, market prices, expected yield levels, and fungicide and application costs warrant an application, farmers should consult the *North Central Regional Committee on Management of Small Grain Diseases* (NCERA-184) fungicide efficacy chart on page 46 of this report.

Many new varieties possessing multiple valuable traits and with high yield potential are currently in the breeding and selection process. The first six varieties emphasized below are based on their order of relative performance for the past three years. Snowmass and Brawl CL Plus are included because of specific traits they possess.

Variety Selection Under Dryland Production Conditions

Byrd (CSU/PG 2011) – In addition to being the top-yielding variety in each of the past three years of dryland testing, it is very drought tolerant and has excellent milling and baking qualities. It is medium maturity and medium height, has medium test weight, and an intermediate reaction to stripe rust. It was the top-yielding variety in the 2012 COFT.

Denali (CSU/PG 2011) – A medium to late-maturing HRW variety that is marketed by the Colorado Wheat Research Foundation for production in Colorado and marketed for production in Kansas through the Kansas Wheat Alliance. It has been high yielding, though only average-yielding in Colorado in 2012, due to its photoperiod sensitivity and relative lateness this year. It is medium tall, has average milling and baking quality, and is moderately susceptible to the new races of stripe rust.

Ripper (CSU/PG 2006) – An early-maturing HRW variety that is high yielding, very drought stress tolerant, taller than Hatcher, and has excellent baking quality. It has relatively lower test weight, and is susceptible to stripe rust. Ripper has shown extremely stable yields, being in the top four of the three-year yield averages from 2005 to 2012.

Settler CL (NE 2008) – This later maturing HRW variety is a single-gene Clearfield® winter wheat that performed very well in the 2008 – 2011 trials, but had average performance in 2012 in the dryland variety performance trials and COFT. It has medium height, good test weight, good milling and baking quality, and is moderately susceptible to the new races of stripe rust.

TAM 112 (TX/W 2005) – An early-maturing HRW with good dryland adaptation. TAM 112 has excellent wheat streak mosaic virus tolerance, high test weight and good baking quality. It is susceptible to stripe rust. It had above average yields in the 2012 dryland variety performance trials and below average yields in the 2012 COFT.

Hatcher (CSU/PG 2004) – This medium-maturing, high-yielding HRW variety was planted on more Colorado wheat acres in 2008 - 2012 than any other variety. It had average yield performance in the 2012 dryland trials and COFT. It has good stress tolerance, good test weight, with moderate resistance to stripe rust, and good milling and baking quality. Hatcher is relatively short and develops a "speckling" condition on the leaves in the spring in the absence of any disease. Hatcher remains a highly recommended HRW wheat variety based on its yield record over many years, stress tolerance, and moderate resistance to stripe rust.

Brawl CL Plus (CSU/PG 2011) – A two-gene HRW Clearfield variety. In combination with methylated seed oil (MSO), control of feral rye with Beyond® herbicide is much improved relative to control achieved with single-gene Clearfield wheat varieties. Brawl CL Plus had excellent yields in 2012 in both the dryland variety trials and the COFT albeit only average yields over the past three years. Brawl CL Plus has early maturity and medium height, excellent test weight, an intermediate reaction to stripe rust, and excellent milling and baking quality.

Snowmass (CSU/PG 2009) – This hard white wheat (HWW) variety distinguishes itself by unique and remarkably high milling and baking quality and is handled in the CWRF ConAgra Mills Ultragrain® Premium Program. It is medium maturing, has good test weight, and is a taller semi-dwarf which provides additional crop residue. It has excellent resistance to wheat streak mosaic virus and moderate sprouting tolerance. It's excellent resistance to stripe rust was ineffective against new races of stripe rust that appeared in 2012. It had below average yields in the 2012 dryland variety trials and COFT yet was in the top-yielding group in prior testing (2009-2011 three year average).

Variety Selection Under Irrigated Production Conditions at Haxtun, Rocky Ford, and Fort Collins

The most important variety selection criteria for irrigated varieties are yield, straw strength, and stripe rust resistance. The top three yielding varieties at each trial location based on a three-year average are emphasized below.

Haxtun

Armour – An early maturing Westbred release (2008) first entered in CSU trials in 2009. It is a short semi-dwarf, with prolific tillering, moderate susceptibility to new races of stripe rust, and good straw strength. **Brawl CL Plus** – See dryland description above. It has above average straw strength and an intermediate reaction to stripe rust. **Byrd** – See dryland description above. It has average straw strength and an intermediate reaction to stripe rust.

Rocky Ford

Byrd – See above descriptions. **Settler CL** – See dryland description above. It has good straw strength and is moderately susceptible to new races of stripe rust. **Ripper** – See dryland description above. It has average straw strength and is susceptible to stripe rust.

Fort Collins

Byrd – See above descriptions. **Ripper** – See above descriptions. **Hatcher** – See dryland description above. It has below-average straw strength and moderate resistance to stripe rust.

Description of Winter Wheat Varieties in Eastern Colorado Trials (2011 and 2012)

Name, Class, and Pedigree	Origin	RWA*	HD	HT	SS	COL**	YR	LR	WSMV	TW	MILL	BAKE	Comments
Above Hard red winter TAM 110*4/FS2	CSU-TX 2001	S	4	5	3	9	9	9	5	7	4	7	CSU/Texas A&M release (2001). Single-gene Clearfield* wheat. Early maturing semidwarf, excellent dryland yield in CO. Leaf and stripe rust susceptible. Marginal baking quality.
Armour Hard red winter B1551-WH/KS94U326	Westbred 2008	S	1	1	3	8	6	5	7	8	4	4	Westbred release (2008). Early maturing short semidwarf, heavy tillering, good leaf rust resistance, moderate susceptibility to new races of stripe rust. Lower test weight.
Aspen Hard white winter TAM 302/B1551W	Westbred 2006	S	3	2	1	8	1	6	7	7	4	6	Westbred release (2006). Hard white winter wheat (HWW), good sprouting tolerance. Short semidwarf, good leaf and stripe rust resistance. Lower test weight.
Bill Brown Hard red winter Yumar/Arlin	CSU 2007	R*	5	3	4	3	6	2	7	3	6	3	CSU release (2007). Good dryland and irrigated yield record in CSU trials. High test weight, good leaf rust resistance, moderate susceptibility to new races of stripe rust. Very susceptible to stem rust. Good baking quality, short coleoptile.
Billings Hard red winter N566/OK94P597	OK 2009	S	7	4	6	6	2	2	--	8	1	1	Oklahoma State release (2009). First entered into CSU Irrigated Variety Trials in 2010. Good leaf and stripe rust resistance. Below average yield in CSU irrigated variety trials.
Bond CL Hard red winter Yumar//TXGH12588-120*4/FS2	CSU 2004	R*	6	6	5	4	8	6	8	8	6	3	CSU release (2004). Single-gene Clearfield* wheat. Slightly later, slightly taller than Above. Good dryland yield, high irrigated yields, good baking quality. Low test weight, leaf and stripe rust susceptible.
Brawl CL Plus Hard red winter Teal 11A/Above//CO99314	CSU 2011	S	4	5	2	8	5	4	--	2	4	2	CSU release (2011). Two-gene Clearfield* wheat. Excellent test weight, straw strength, milling and baking quality. Early maturity, medium height, long coleoptile. Moderate resistance to leaf rust, intermediate reaction to stripe rust.
Byrd Hard red winter TAM 112/CO970547-7	CSU 2011	S	5	5	4	7	5	6	--	5	2	2	CSU release (2011). High yield, excellent drought stress tolerance and quality. Medium height, maturity, coleoptile length. Average test weight, average straw strength. Intermediate reaction to stripe rust, resistant to Ug99 race of stem rust.
Camelot Hard red winter KS91H184/Arlin SIB//KS91HW29/3/NE82761/Redland/4/VBF0168	NE 2008	S	3	7	7	4	4	2	7	5	4	3	Nebraska release (2008). Medium-early, tall wheat. Good leaf rust resistance, moderately resistant to stripe rust. Below average three year yield average in CSU trials, though higher in Northeast Colorado.
Clara CL Hard white winter KS03HW154(TREGO/CO960293)/KS03HW1(FIDEL/97HW150//97HW349/3/TGO)	KSU 2011	S	6	5	6	--	4	--	2	2	5	5	KSU-Hays release (2011). Single-gene hard white Clearfield* wheat. First entered in CSU Variety Trials in 2012. Carries same WSMV resistance as RonL and Snowmass. Moderate resistance to stripe rust, excellent test weight.

Russian wheat aphid resistance (RWA), heading date (HD), plant height (HT), straw strength (SS), coleoptile length (COL), stripe rust resistance (YR), leaf rust resistance (LR), wheat streak mosaic virus tolerance (WSMV), test weight (TW), milling quality (MILL), and baking quality (BAKE). Rating scale: 1 - very good, very resistant, very early, or very short to 9 - very poor, very susceptible, very late, or very tall.

* RWA rating denotes resistance to the original biotype (biotype 1) of RWA. All available cultivars are susceptible to the new biotypes of RWA.

** Coleoptile length ratings range from 1=very short (~ 50 mm or ~2 in) to 9=very long (~100 mm or ~4 in). Coleoptile lengths should be interpreted for relative variety comparisons only.

Description of Winter Wheat Varieties in Eastern Colorado Trials (2011 and 2012)

Name, Class, and Pedigree	Origin	RWA*	HD	HT	SS	COL**	YR	LR	WSMV	TW	MILL	BAKE	Comments
CO05W111 Hard white winter CO980829/TAM 111	CSU exp	S	7	7	3	6	6	7	--	3	5	3	CSU hard white experimental, targeted for potential release in 2012. Good dryland and irrigated yield, medium-tall plant height, medium-late maturity, good test weight, good straw strength. Moderate susceptibility to new races of stripe rust.
CO07W245 Hard white winter KS01HW152-1/TAM 111	CSU exp	S	5	5	2	6	3	6	--	3	2	5	CSU hard white experimental line, targeted for potential release in 2012. High dryland and irrigated yield, medium height and maturity, good test weight, good straw strength. Moderate resistance to stripe rust.
CSU Blend09 Hard red winter Hatcher-Ripper Blend	CSU 2004/2006	--	--	--	--	--	--	--	--	--	--	--	50:50 blend of Hatcher and Ripper. First entered into CSU Dryland Variety Trial (UVPT) in 2009.
CSU Blend12 Hard red winter Hatcher-Byrd Blend	CSU 2004/2011	--	--	--	--	--	--	--	--	--	--	--	50:50 blend of Hatcher and Byrd. First entered into CSU Dryland Variety Trial (UVPT) in 2012.
Danby Hard white winter TREGO/JGR 8W	KSU 2005	S	4	5	4	6	9	8	5	2	2	7	KSU-Hays release (2005). Hard white wheat (HWW), very high test weight. Similar to Trego with improved sprouting tolerance. Lower baking quality, stripe rust susceptible.
Denali Hard red winter CO980829/TAM 111	CSU 2011	S	7	7	3	8	6	8	7	2	4	6	CSU release (2011). High dryland and irrigated yields, average milling and baking quality. Medium tall, medium-late, medium coleoptile length. Excellent test weight, average straw strength. Moderate susceptibility to new races of stripe rust.
Duster Hard red winter WO405D/HGF112//W7469C/HCF012	OK 2006	S	8	8	3	4	4	3	7	4	6	3	Oklahoma State release (2006). Medium tall, medium late, short coleoptile, leaf rust resistant, moderately resistant to stripe rust. Below average three year yield average in CSU trials, though higher in Southeast Colorado.
Everest Hard red winter HBK1064-3/KS84063-9-39-3-4W//VBF0589-1/IL89-6483	KSU 2009	S	5	2	--	7	8	3	7	3	3	8	KSU-Manhattan release (2009). First entered into CSU Variety Trials in 2010. Good leaf rust and barley yellow dwarf virus resistance. Susceptible to new races of stripe rust Targeted for production in more eastern portions of the Plains. Marginal baking quality.
Fuller Hard red winter Bulk selection	KSU 2006	S	2	3	7	3	7	5	5	6	5	2	KSU-Manhattan release (2006). Early maturing semidwarf. Average test weight, good leaf rust resistance, stripe rust susceptible. Lower straw strength. Below average three year yield average in CSU trials.
Greer Hard red winter HBK0935-29-15/KS90W077-2-2/VBF0589-1	Agripro 2009	S	5	2	3	9	2	5	--	8	7	3	Agripro release (2009). First entered in CSU Variety Trials in 2011. Medium early, medium short. Lower test weight.

Russian wheat aphid resistance (RWA), heading date (HD), plant height (HT), straw strength (SS), coleoptile length (COL), stripe rust resistance (YR), leaf rust resistance (LR), wheat streak mosaic virus tolerance (WSMV), test weight (TW), milling quality (MILL), and baking quality (BAKE). Rating scale: 1 - very good, very resistant, very early, or very short to 9 - very poor, very susceptible, very late, or very tall.

* RWA rating denotes resistance to the original biotype (biotype 1) of RWA. All available cultivars are susceptible to the new biotypes of RWA.

** Coleoptile length ratings range from 1=very short (~ 50 mm or ~2 in) to 9=very long (~100 mm or ~4 in). Coleoptile lengths should be interpreted for relative variety comparisons only.

Description of Winter Wheat Varieties in Eastern Colorado Trials (2011 and 2012)

Name, Class, and Pedigree	Origin	RWA*	HD	HT	SS	COL**	YR	LR	WSMV	TW	MILL	BAKE	Comments
Hatcher Hard red winter Yuma/PI 372129//TAM-200/3/4*Yuma/4/KS91H184/Vista	CSU 2004	R*	6	2	6	6	3	7	8	4	4	3	CSU release (2004). Medium maturing semidwarf. Good test weight, moderate resistance to stripe rust. Excellent dryland yield across the High Plains, good milling and baking quality. Develops "leaf speckling" condition.
Hitch Hard red winter 53/3/ABL/1113//K92/4/JAG/5/KS89180B	Westbred 2008	S	6	2	2	4	7	2	7	7	8	5	Westbred release (2008). Positioned for High Plains irrigated production. Good straw strength, good leaf rust resistance, stripe rust susceptible, lower milling and baking quality, lower test weight.
Infinity CL Hard red winter Windstar/3/NE94481//TXGH125888-120*4/FS2	NE 2004	S	5	7	6	6	3	3	6	5	5	5	Nebraska release (2005). Single-gene Clearfield* wheat. Medium maturing, taller wheat, moderate resistance to stripe rust. Improved baking quality relative to Above. Develops "leaf speckling" similar to Hatcher.
Jagger Hard red winter KS82W418/Stephens	KSU 1994	S	3	5	5	2	8	9	5	7	3	4	KSU-Manhattan release (1994). Early maturing semidwarf, good baking quality, good WSMV tolerance, very leaf and stripe rust susceptible. Breaks dormancy very early in the spring.
Judee Hard red winter Vanguard/Norstar//Judith dwf/3/NuHorizon	MT 2011	S	9	2	--	--	3	--	--	--	--	--	Montana State University release (2011), first entered in CSU Variety Trials in 2012. Carries solid stem trait conferring some protection against wheat stem sawfly damage. Very late maturing, very low yield in 2012 CSU dryland trials.
McGill Hard red winter NE92458/Ike	NE 2010	S	6	6	8	1	6	--	--	7	5	3	Nebraska release (2010). First entered in CSU Variety Trials in 2011. Medium maturity, medium height. Lower test weight, poor straw strength. Intermediate reaction to new races of stripe rust.
Prairie Red Hard red winter CO850034/PI372129//5*TAM 107	CSU 1998	R*	4	3	3	8	8	9	5	7	4	7	CSU release (1998). Backcross derivative of TAM 107, resistant to RWA biotype 1. Good stress tolerance, poor end-use quality reputation, lower yields relative to more recent wheat releases. Leaf and stripe rust susceptible.
Protection Hard red winter Jagger//TXGH12588-120*4/FS2	AGSECO/CSU 2004	S	3	7	3	4	7	9	5	8	4	7	CSU release (2004), marketed by AGSECO. Single-gene Clearfield* wheat. Lower yield relative to Bond CL in CSU Variety Trials. Taller plant stature, susceptible to stripe rust. Low test weight.
Ripper Hard red winter CO940606/TAM107R-2	CSU 2006	R*	2	4	4	9	9	9	7	8	4	4	CSU release (2006). Excellent stress tolerance, high dryland yields in Colorado, good baking quality. Very good recovery from stand reduction. Leaf and stripe rust susceptible, lower test weight.
Robidoux Hard red winter NE96644/Wahoo (sib)	NE 2010	S	5	3	6	7	4	--	--	5	5	3	Nebraska release (2010). First entered in CSU Variety Trials in 2011. Medium maturity, medium short. Moderate resistance to stripe rust.

Russian wheat aphid resistance (RWA), heading date (HD), plant height (HT), straw strength (SS), coleoptile length (COL), stripe rust resistance (YR), leaf rust resistance (LR), wheat streak mosaic virus tolerance (WSMV), test weight (TW), milling quality (MILL), and baking quality (BAKE). Rating scale: 1 - very good, very resistant, very early, or very short to 9 - very poor, very susceptible, very late, or very tall.

* RWA rating denotes resistance to the original biotype (biotype 1) of RWA. All available cultivars are susceptible to the new biotypes of RWA.

** Coleoptile length ratings range from 1=very short (~ 50 mm or ~2 in) to 9=very long (~100 mm or ~4 in). Coleoptile lengths should be interpreted for relative variety comparisons only.

Description of Winter Wheat Varieties in Eastern Colorado Trials (2011 and 2012)

Name, Class, and Pedigree	Origin	RWA*	HD	HT	SS	COL**	YR	LR	WSMV	TW	MILL	BAKE	Comments
Settler CL Hard red winter N95L164/3/MILLENNIUM SIB//TXGH125888-120*4/FS2	NE 2008	S	8	5	3	5	6	8	7	6	3	3	Nebraska release (2008). Single-gene Clearfield* wheat. Good dryland and irrigated yield in CSU Variety Trials. Later maturing, medium height. Moderately susceptible to new races of stripe rust.
Smoky Hill Hard red winter 97 8/64 MASA	Westbred 2006	S	6	3	4	5	8	5	8	5	5	3	Westbred release (2006). Medium late, shorter semidwarf. Good leaf rust resistance, stripe rust susceptible, good baking quality. Below average three year yield average in CSU trials.
Snowmass Hard white winter KS96HW94//Trego/CO960293	CSU 2009	S	7	6	8	5	6	6	2	4	6	2	CSU release (2009). Hard white winter wheat (HWW). Medium-maturing, medium-tall. Good resistance to wheat streak mosaic virus, moderate susceptibility to new races of stripe rust, moderate sprouting tolerance. Grown under contract with ConAgra.
SY Gold Hard red winter W95-301/W98-151	Agripro 2010	S	4	5	5	2	7	2	6	3	5	5	Agripro release (2010). First tested in CSU trials in 2009. Good leaf rust resistance, susceptible to stripe rust. Good milling quality, lower baking quality. Below average three year yield average in CSU trials, though slightly higher in Northeast Colorado.
SY Wolf Hard red winter W99-331/97x0906-8	Agripro 2011	S	6	4	3	5	4	4	--	5	5	4	Agripro release (2011). First entered in CSU Variety Trials in 2011. Good milling quality, poor baking quality. Good resistance to tan spot and septoria, moderate resistance to stripe rust and leaf rust.
T158 Hard red winter KS93U206/2*T81	Limagrain 2009	S	2	5	5	--	2	7	--	4	2	6	Trio (Limagrain) release (2009). First entered in CSU Variety Trials in 2012. Good stripe rust resistance, top dryland yields on a two-year average in Western KS trials.
T163 Hard red winter 93WGRC27/T811	Limagrain 2010	S	3	4	8	4	3	--	4	6	2	2	Trio (Limagrain) release (2010). First entered in CSU Variety Trials in 2011. Some plants carry resistance to wheat streak mosaic virus. Moderate resistance to stripe rust. Poor straw strength.
TAM 111 Hard red winter TAM-107//TX78V3630/CTK78/3/TX87V1233	TX 2002	S	6	7	3	8	5	8	7	2	4	5	Texas A&M release (2002), marketed by Agripro. Medium maturing, taller wheat. Good test weight, good straw strength, good irrigated yield. Leaf rust susceptible, intermediate reaction to stripe rust.
TAM 112 Hard red winter U1254-7-9-2-1/TXGH10440	TX 2005	S	2	4	7	7	7	7	3	2	4	1	Texas A&M release (2005), marketed by Watley Seed. Good test weight, good quality, excellent wheat streak mosaic virus tolerance. Susceptible to leaf and stripe rust, poor straw strength.
TAM 113 Hard red winter TX90V6313/TX94V3724	AGSECO 2010	S	5	5	8	--	2	2	--	3	5	5	Texas A&M release (2010), marketed by AGSECO. First entered in CSU Variety Trials in 2012. Good leaf and stripe rust resistance, good test weight. Poor straw strength.

Russian wheat aphid resistance (RWA), heading date (HD), plant height (HT), straw strength (SS), coleoptile length (COL), stripe rust resistance (YR), leaf rust resistance (LR), wheat streak mosaic virus tolerance (WSMV), test weight (TW), milling quality (MILL), and baking quality (BAKE). Rating scale: 1 - very good, very resistant, very early, or very short to 9 - very poor, very susceptible, very late, or very tall.

* RWA rating denotes resistance to the original biotype (biotype 1) of RWA. All available cultivars are susceptible to the new biotypes of RWA.

** Coleoptile length ratings range from 1=very short (~ 50 mm or ~2 in) to 9=very long (~100 mm or ~4 in). Coleoptile lengths should be interpreted for relative variety comparisons only.

Description of Winter Wheat Varieties in Eastern Colorado Trials (2011 and 2012)

Name, Class, and Pedigree	Origin	RWA*	HD	HT	SS	COL**	YR	LR	WSMV	TW	MILL	BAKE	Comments
TAM 304 Hard red winter TX92U3060/TX91D6564 (=X95U104-P66)	Scott Seed 2006	S	4	2	2	--	8	2	--	5	7	5	Texas A&M release (2006), marketed by Scott Seed Co. First entered in CSU Variety Trials in 2012. Good straw strength, susceptible to stripe rust, lower test weight.
Thunder CL Hard white winter KS01-5539/CO99W165	CSU 2008	R*	4	4	3	7	3	5	4	6	5	2	CSU release (2008). Single-gene hard white Clearfield* wheat. Good straw strength for irrigation. Excellent quality, moderate resistance to stripe rust and wheat streak mosaic virus, moderate sprout susceptibility. Grown under contract with ConAgra.
WB-Cedar Hard red winter TAM 302/B1551W	Westbred 2010	S	2	2	1	5	2	5	7	7	4	6	Westbred release (2010). First entered in CSU Variety Trials in 2011. Hard red sister selection to Aspen hard white wheat. Good stripe rust resistance, excellent straw strength for high-input irrigation. Lower test weight.
WB-Stout Hard red winter KS94U275/1878//Jagger	Westbred 2009	S	1	3	5	4	8	2	--	8	8	3	Westbred release (2009). First tested in CSU trials in 2010. Good leaf rust resistance, stripe rust susceptible, lower test weight. Below average yield in CSU trials.
Winterhawk Hard red winter 474S10-1/X87807-26//HBK0736-3	Westbred 2007	S	5	5	5	8	5	7	7	2	2	4	Westbred release (2007). Medium maturing, medium tall, longer coleoptile. Intermediate reaction to new races of stripe rust, susceptible to leaf rust, very susceptible to stem rust. Good test weight, good quality.
Yuma Hard red winter NS14/NS25//2*Vona	CSU 1991	S	6	3	3	1	5	5	6	6	5	3	CSU release (1991). Medium maturity, semidwarf, short coleoptile, good baking quality characteristics. Moderate resistance to stripe rust. Good yields especially under irrigation.

Russian wheat aphid resistance (RWA), heading date (HD), plant height (HT), straw strength (SS), coleoptile length (COL), stripe rust resistance (YR), leaf rust resistance (LR), wheat streak mosaic virus tolerance (WSMV), test weight (TW), milling quality (MILL), and baking quality (BAKE). Rating scale: 1 - very good, very resistant, very early, or very short to 9 - very poor, very susceptible, very late, or very tall.

* RWA rating denotes resistance to the original biotype (biotype 1) of RWA. All available cultivars are susceptible to the new biotypes of RWA.

** Coleoptile length ratings range from 1=very short (~ 50 mm or ~2 in) to 9=very long (~100 mm or ~4 in). Coleoptile lengths should be interpreted for relative variety comparisons only.

CSU Wheat Breeding and Genetics Program Update (August 2012)

Scott Haley, CSU Wheat Breeder

Introduction

The primary goal of the CSU Wheat Breeding and Genetics Program is to develop and release improved wheat cultivars and germplasm adapted for the diverse production conditions in Colorado and the High Plains region. Over nearly 50 years of continuous wheat improvement at CSU we have developed a germplasm base uniquely adapted for the High Plains region and have brought many new cultivars to the market to address production and marketing constraints facing Colorado's wheat producers.

We are fortunate to receive generous funding support from the CSU Colorado Ag Experiment Station and from the Colorado wheat industry through the Colorado Wheat Administrative Committee (CWAC) and the Colorado Wheat Research Foundation (CWRF). The funding we receive, enhanced considerably with the CWAC assessment increase in 2007, supports several different activities focused on wheat cultivar development. The following descriptions of these activities highlight our progress over the last few years, particularly since the CWAC assessment increase in 2007.

Breeding Program Core

The primary goal of our breeding program is the development and release of improved wheat cultivars adapted for Colorado and the High Plains region. Funding provided by CWAC is a vital complement to the excellent support that we receive from the Colorado Ag Experiment Station. We currently have five full-time research associates working on our program with over 50% of their salary support coming from CWAC.

Three new hard red winter (HRW) wheat cultivars were released in fall 2011. These include Byrd (CO06424; TAM 112/CO970547-7), Denali (CO050303-2; CO980829/TAM 111), and Brawl CL Plus (CO06052; Teal 11A/Above//CO99314). Byrd and Denali have shown high grain yield, good test weight, and good stripe rust resistance. Brawl CL Plus, the first public two-gene Clearfield winter wheat in the US, has shown lower yield statewide, but higher yield in northeast Colorado where Clearfield wheats are more popular. Byrd and Brawl CL Plus have very good baking quality while quality of Denali is average.

CO07W245 (KS01HW152-1/TAM 111) hard white winter wheat (HWW) was approved for release as a new cultivar in early August. Grain yield of CO07W245 has been similar to Byrd with improved test weight and stripe rust resistance. Baking quality of CO07W245 is good though it lacks the super-strong dough mixing properties of Snowmass. Pre-harvest sprouting tolerance of CO07W245 is similar to Hatcher and Snowmass (Snowmass>Thunder CL>Platte).

CO05W111 (CO980829/TAM 111) was also on Foundation Seed increase in 2012 but was not proposed for release due to lower yields and stripe rust resistance compared to CO07W245. With decreased interest in HWW in recent years (outside of the ConAgra identity-preserved model), we have brought our HRW and HWW closer to a 50:50 balance. Our partnership with ConAgra is providing for an expansion of experimental line development through the use of doubled haploid (DH) breeding technology. We received 1,000 new DH lines from Heartland Plant Innovations (HPI) in fall 2011 and these were increased in Yuma AZ in 2012. Over 300 new DH lines will enter advanced and preliminary yield trials in 2013.

In 2011, we increased the numbers of new lines selected by nearly 80% over previous years (i.e., 1013 in 2011, 1815 in 2012). We have accommodated this by planting preliminary trials at fewer locations (2 instead of 4) and implementing a short-plot trial scheme at Fort Collins. The goal of this expansion is to provide greater rates of genetic gain.

In fall 2011, we planted over 17,000 yield trial plots across 14 trial locations in Colorado, in addition to three CSU Elite Trial locations in Kansas, one in Oklahoma, and one in Texas (in collaboration with their university breeding programs). We also planted over 35,000 headrows, over 1,000 early-generation (F2-F4) populations (including 86 two-gene Clearfield populations), and over 1,400 new cross combinations at Fort Collins in fall 2011.

Drought Stress Tolerance
The basic objective of this program is to develop a "pre-breeding capacity" focused on transferring stress tolerance traits from exotic or unadapted germplasm (such as "synthetic wheats") into adapted germplasm in the CSU Wheat Breeding and Genetics Program. Funding provided by CWAC is used for salary/benefits support for a PhD-level research scientist and a modest amount of general research support (supplies, temporary labor, travel).

In 2011, the third and final year of a drought tolerance study was completed at the USDA-ARS Limited Irrigation Research Farm in Greeley. Twenty-four winter wheats with a range of stress responses were planted under five drip-irrigation treatments to improve understanding of the developmental, morphological, and physiological stress tolerance mechanisms in our germplasm. A PhD Beachell-Borlaug Fellow and graduate student Erena Edae (co-advised with Pat Byrne) completed the second year of testing of a CIMMYT mapping panel under contrasting irrigation regimes at Greeley.

In Fall 2011, remote sensing data obtained with the *GreenSeeker* were collected at 10 locations from three different nurseries (CSU Elite Trial, Southern Regional Performance Nursery, and the Synthetic Derivatives). These data will be correlated with yield data in 2012 as an additional validation of the importance of early growth for grain yield of irrigated and dryland wheat in eastern Colorado.

Ninety backcross populations between "synthetic wheat" and TAM 111 or TAM 112 were obtained from Texas A&M in fall 2008. Selections made from these populations were planted in field trials at Walsh and Sheridan Lake in 2011 and several superior selections were identified for crossing. A second group of 12 synthetic wheat populations were obtained in 2009 from Texas A&M and 120 line selections made from these populations were planted at three locations (Dailey, Sheridan Lake, Walsh) in fall 2011. A third set of synthetic wheat populations were planted in spring 2011 and 44 of these were planted as spaced-planted populations in fall 2011. Dr. Marc Moragues accepted a position in Spain and left our program in mid-April 2012. The orientation of this project will shift toward implementation of the new breeding technique known as "Genomic Selection". In spring 2012 we conducted an international search for a new scientist to lead this research. Dr. Eric Storlie recently accepted our offer to come to CSU and he will be joining our program on September 1.

DNA Marker-Assisted Selection
The objectives of this program are to apply DNA molecular marker-assisted selection (MAS) as a tool to improve selection efficiency for traits of interest in the breeding program. Funding

provided by CWAC is used for salary/benefits support for a MS-level research associate and a modest amount of general research support (supplies and lab reagents, temporary labor).

A major part of our marker effort has been implementation of a rapid generation advance scheme ("single seed descent", SSD) for experimental line development. We have initiated five sets of SSD populations since 2008, with each set involving growing three generations (F2-F4) in the greenhouse followed by planting of line selections in the field. Line selections from the first set started in spring 2008 were grown in headrows in 2010 and selections were made for preliminary yield trials in 2011 and advanced yield trials in 2012. Selections from subsequent SSD sets will be working their way through our pipeline in coming years.

Starting in 2012, we have greatly expanded routine marker testing of preliminary lines, including those developed via SSD in prior years. We have significantly expanded the number of our preliminary lines in 2012 (1013 in 2011 vs. 1815 in 2012) and doubled haploid lines developed by Heartland Plant Innovations (funded by ConAgra Mills and CWRF royalties) will further increase the numbers of materials tested in coming years.

We continue to utilize DNA markers for backcrossing new traits from unadapted sources. Materials from these efforts are then used in "forward crosses" for integration through the main flow of our program. In addition to markers routinely in use in our program, several newly identified markers have been optimized in our lab, including those for resistance to *Ug-99* stem rust, stripe rust, and solid stem for wheat stem sawfly.

We are currently implementing a new marker genotyping method known as KASP (KBiosciences Competitive Allele-Specific PCR) for screening for target traits. KASP marker technology is efficient and inexpensive compared to other methodologies. New equipment purchased with CWRF funds in 2011 will contribute to these efforts.

TILLING for Novel Trait Development
The objectives of this program are to develop novel traits using the technique known as TILLING (Targeted Induced Local Lesions In Genomes). TILLING has shown promise in wheat for development of novel traits using mutation induction and advanced molecular biology techniques. TILLING-derived traits are non-GM and may provide new and beneficial technologies for wheat. Funding provided by CWAC is used for salary/benefits support for a PhD-level scientist and an MS-level research associate and CWRF royalty funds are used to cover laboratory expenses.

We established a TILLING population in the CSU winter wheat cultivar Hatcher in 2009 and 2010. We have also obtained a TILLING population in a spring wheat background from the University of California-Davis. Most of our work is being done with the Hatcher population. In 2010, we identified mutants on all three wheat genomes in a gene associated with drought stress tolerance. To enable trait validation, multiple mutants are currently being backcrossed and "stacked" into adapted backgrounds to determine the optimum combination of mutant "events" needed for stress tolerance.

In 2011, we purchased three new equipment items that will help to accelerate our TILLING program. These include an automated plate reader, an automated liquid handling system, and a DNA fragment analyzer.

In 2011, our TILLING efforts focused on genes related to wheat stem sawfly (WSS) attractiveness and several human health-related traits. For WSS, we have identified several mutants in a gene that may disrupt production of a chemical (volatile) in the wheat plant that attracts WSS.

We are conducting pilot experiments to explore the use of next-generation DNA sequencing technology for the new technique "TILLING-by-sequencing". If successful, we expect that TILLING-by-sequencing will greatly enhance our capacity for novel trait development.

Russian Wheat Aphid Resistance
The objectives of this program are to incorporate resistance to Russian Wheat Aphid (RWA) into germplasm in our breeding program. Funding provided by CWAC is used for partial salary/benefits (1/3 of the total) for one research associate with the remaining provided by the Colorado Ag Experiment Station RWA project.

Four RWA-resistant experimental lines were tested in the 2011 dryland variety trial (UVPT). Two of the lines are in the background of the previously discarded line CO00554 (TAM 302/Akron//Halt) and two are in a Yuma background. None of the lines were yield-competitive with Byrd, Denali, or any of our best experimental lines and thus each has been discarded from further release consideration.

In 2011, we evaluated a group of lines in a Snowmass background carrying resistance to RWA biotype 2 derived from two resistant germplasm accessions (PI 572652, PI 626580). Based on RWA biotype 2 resistance, and grain yield and test weight in field trials at Fort Collins, eight lines were selected and advanced for further testing in 2012. A decision on further testing of these materials will be made after harvest in 2012.

Several headrow populations derived from crosses with various RWA resistance sources were in the field at Fort Collins in 2011. Evaluations in the insectary during winter 2011-12 identified 31 lines that show some degree of RWA biotype 2 resistance. These lines will be planted in 2012 in Preliminary Yield Trials at Fort Collins, Burlington, and Walsh.

A group of 565 lines in a Bill Brown background carrying RWA biotype 2 resistance are under seed increase in Yuma, AZ. The source of resistance in these lines is the "reconstructed" *Dn7* source we developed that potentially corrects the poor baking quality associated with the original *Dn7* source. We also have a group of lines in a Yuma background carrying RWA biotype 2 resistance from CI 2401 under seed increase in Yuma, AZ. These materials will be especially useful for future biotype monitoring.

We are nearing completion of a five-year grant-funded (Australian GRDC) project focusing on RWA resistance breeding and genetics (in collaboration with Frank Peairs). In this project we successfully transferred resistance to Australian wheat and barley backgrounds and also evaluated several mapping populations to identify markers for RWA resistance genes.

End-Use Quality Improvement
The objectives of this program are to conduct end-use quality tests on experimental lines in our breeding program and those collected from the state dryland (UVPT) and irrigated (IVPT) variety trials. Funding provided by CWAC is used for temporary labor and for repair/

maintenance of laboratory equipment. The Colorado Ag Experiment Station provides funding (11 months) for a full-time Senior Research Associate who manages the wheat quality lab during the winter months.

Comprehensive milling and baking quality evaluations are done annually at several stages of our breeding program. Each year we do about 2,000 single kernel characterization system (SKCS) tests, 2,000 Mixographs, 600 polyphenol oxidase (PPO) assays, and 600 full-scale Quadrumat Senior milling and pup-loaf baking tests.

Comprehensive quality evaluations are done on selected locations of the state dryland (UVPT) and irrigated (IVPT) variety trial program every year. Data from evaluations are now reported on an annual basis in the *Making Better Decisions* technical report. Milling and baking quality scores in the "Variety Characteristics Table" are now updated annually from the multiple year and multiple location evaluations.

In 2011 we finalized development of a set of near-isogenic lines (NILs) in a Ripper background that differ for the presence of high molecular weight glutenin subunits that influence dough mixing properties. This experiment is part of the dissertation research for a new graduate student that joined our program in 2011 with funding obtained through our partnership with ConAgra Mills.

CO07W245 Hard White Winter Wheat
Colorado State University Wheat Breeding Program

General

- Pedigree - KS01HW152-1/TAM 111; cross made 2003
  (KS01HW152-1 = Trego/Betty sib)
- Characteristics

Chaff color	white	Stripe Rust	resistant
Awns	awned	Leaf Rust	susceptible
Plant height	medium	Stem Rust	moderately resistant
Maturity	medium	Powdery mildew	unknown
Coleoptile length	medium	Hessian Fly	heterogeneous
Straw strength	very good	RWA (biotype 1 and 2)	susceptible
Test weight	excellent	WSBMV/WSSMV	moderately resistant
Sprout tolerance	good (~Hatcher)	BYDV, WSMV	moderately susceptible

Field Performance

CO07W245 has been tested in Colorado and Western Kansas in the CSU Elite Trial since 2010. Data from these trials are summarized below; entries are ranked by the three-year dryland average (**bold**).

Entry	2010	2011	2012	2 Year Avg	3 Year Avg	TestWt Avg	NE CO	SE CO	Irrig CO	Western KS
Byrd	62.1	55.8	59.3	57.8	**59.2**	59.6	63.8	51.0	114.4	61.8
CO07W245	**64.7**	**56.6**	**52.8**	**54.4**	**57.7**	**60.0**	**63.1**	**48.1**	**119.2**	**66.2**
Hatcher	57.4	55.6	50.5	52.7	**54.2**	59.5	58.2	46.9	106.1	65.9
Denali	60.2	52.5	50.3	51.3	**54.1**	60.2	59.3	44.9	113.4	64.6
Ripper	56.5	53.3	52.8	53.0	**54.1**	58.2	58.4	46.4	106.0	55.2
Brawl CL Plus	57.1	51.5	52.8	52.2	**53.8**	60.5	60.0	42.6	104.2	67.3
Bill Brown	59.4	52.3	50.1	51.0	**53.7**	60.0	58.1	45.9	108.2	60.9
TAM 112	56.5	48.9	52.4	50.9	**52.7**	60.0	57.4	44.3	104.1	58.6
Winterhawk	57.2	49.4	50.6	50.1	**52.4**	60.3	58.2	42.0	115.1	66.7
Above	51.7	52.2	51.4	51.7	**51.7**	59.1	57.4	41.5	102.3	57.4
Thunder CL	53.8	50.1	48.8	49.3	**50.8**	58.6	57.1	39.4	107.0	57.1
CO05W111	58.9	48.5	45.7	46.9	**50.8**	59.4	55.4	42.3	111.6	58.5
Snowmass	51.5	52.7	46.4	49.1	**49.9**	59.6	54.4	41.6	105.0	54.5
Average	57.5	52.3	51.1	51.6	**53.5**	59.6	58.5	44.4	109.0	61.1
Locations	9	8	11	19	**28.0**	28.0	18	10	5	8

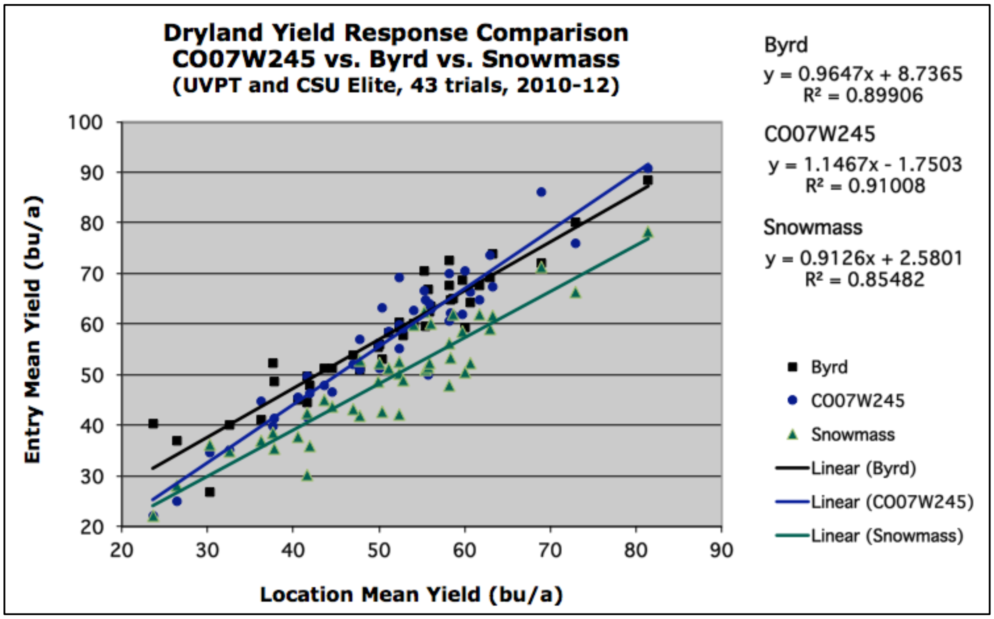
CO07W245 was tested in the Colorado Dryland Uniform Variety Performance Trial (UVPT) in 2011 and 2012. Data from these trials are summarized at right; entries are ranked by the two-year dryland average (**bold**).

CO07W245 was also tested in the Colorado Irrigated Variety Performance Trial (IVPT) in 2012. CO07W245 performed well-above average at both Haxtun and Rocky Ford as well as the limited-irrigation trial at Fort Collins. Data from these trials may be found at:

http://csucrops.com

Entry	2011 Yield	2012 Yield	Average Yield	NE Yield	SE Yield	Average TestWt
Byrd	56.0	54.9	**55.4**	59.2	47.6	60.4
CO07W245	**54.8**	**54.6**	**54.7**	**59.8**	**44.4**	**60.7**
TAM 112	50.3	51.6	**51.1**	55.6	42.0	61.1
Ripper	50.6	51.0	**50.9**	54.8	43.1	59.2
Denali	52.1	48.9	**50.2**	54.9	40.7	60.9
Hatcher	52.8	48.2	**50.0**	53.4	43.3	60.2
Above	49.7	49.0	**49.3**	53.8	40.3	59.5
Bill Brown	51.0	48.0	**49.2**	53.1	41.4	60.8
SY Wolf	49.2	49.1	**49.2**	55.5	36.6	60.2
Settler CL	50.3	48.4	**49.1**	53.7	40.0	60.0
Brawl CL Plus	45.8	50.9	**48.9**	54.0	38.6	60.8
CO05W111	48.9	48.5	**48.7**	53.0	39.9	60.1
Winterhawk	48.4	48.6	**48.5**	53.2	39.1	60.9
T163	48.2	48.7	**48.5**	52.8	39.9	60.3
Snowmass	50.2	45.8	**47.6**	50.8	41.1	59.8
Robidoux	46.4	47.9	**47.3**	51.4	39.2	60.1
Thunder CL	46.8	46.3	**46.5**	50.9	37.7	59.5
Armour	46.2	46.6	**46.4**	50.9	37.5	59.5
Bond CL	46.5	46.3	**46.4**	50.4	38.2	58.0
McGill	45.5	45.8	**45.7**	50.4	36.2	59.5
Everest	45.3	45.6	**45.5**	50.4	35.7	60.9
Average	49.3	48.8	**49.0**	53.4	40.1	60.1
Locations	6	9	**15**	10	5	15

Regression of entry mean yield for CO07W245, Byrd, and Snowmass on location mean yield of 43 replicated, dryland trials in Colorado from 2010 to 2012.



CO07W245 was tested in the 2012 Southern Regional Performance Nursery (SRPN). Averaged across nine available trials (four each in Colorado and Nebraska, one in Kansas), CO07W245 was the second highest yielding entry in the trial.

End-Use Quality

CO07W245 has been evaluated in comprehensive milling and baking quality tests in the CSU Wheat Quality Laboratory since 2009. Byrd was included in these tests as an excellent quality HRW check and Snowmass and Thunder CL were included as excellent quality hard white wheat (HWW) checks.

Trait (unit of measurement)	Samples	CO07W245	Byrd	Snowmass	Thunder CL
SKCS kernel weight (mg) †	29	31.0	26.8 *	30.3 ns	28.8 *
SKCS kernel diameter (mm)	29	2.71	2.52 *	2.71 ns	2.63 *
SKCS kernel hardness (score)	29	63.7	67.3 *	77.9 *	68.8 *
Test weight (lb/bu)	16	60.4	59.4 *	59.3 *	58.7 *
NIR wheat ash (%)	29	1.42	1.44 *	1.47 *	1.46 *
Flour extraction (%)	17	69.8	71.4 *	66.5 *	68.5 *
NIR flour ash (%)	25	0.42	0.42 ns	0.46 *	0.41 *
Polyphenol oxidase (L-Dopa)	15	0.53	0.51 ns	0.57 ns	0.52 ns
Grain color (Minolta L*)	15	58.0	56.4 *	58.7 *	60.0 *
Wheat protein content (%)	28	12.3	12.4 ns	12.5 ns	13.0 *
Mixograph mixing time (min)	24	4.4	6.3 *	7.3 *	4.8 *
Mixograph tolerance (score) ‡	16	2.7	5.0 *	5.7 *	4.1 *
Bake mix time (min)	16	4.1	6.2 *	7.7 *	4.6 *
Bake absorption (%)	16	61.5	63.0 *	63.7 *	63.4 *
Loaf volume (cc)	16	850	1054 *	976 *	1009 *
Crumb grain (score) ‡	16	2.9	4.6 *	5.4 *	4.3 *
Milling Rating		Excellent	Excellent	Good	Good
Baking Rating		Good	Excellent	Excellent	Excellent

† Single kernel characterization system (SKCS).

‡ Mixograph tolerance and crumb grain scores: 0=very poor, 6=very good.

* Value significantly different from CO07W245 based on a paired t-test at the 5% probability level; ns=not significant.

CWRF Launches New PlainsGold Brand for Wheat Varieties

Glenda Mostek

The Colorado Wheat Research Foundation (CWRF) is excited to launch the new PlainsGold brand to market all Colorado State University (CSU)-developed wheat varieties, which the organization owns.

The new brand is the result of an extensive task force project, which looked at ways to increase certified seed sales and thereby increase royalty funding to the CSU wheat breeding program. The PlainsGold brand will offer farmers innovative new varieties like Byrd, Denali and Brawl CL Plus in addition to the same great varieties they've trusted for years – like Hatcher, Ripper, Bill Brown and Snowmass.

"As we looked for ways to expand our reach and compete with private companies we developed a task force to research the best ways to increase sales and return more royalty dollars back to the CSU wheat breeding program," said CWRF President Dan Anderson.

A task force, which included seed growers, wheat farmers, members of the CSU wheat breeding team, CWRF staff, and marketing consultants researched opportunities to expand the organization's market reach and offer more of the industry-leading varieties to a larger audience of wheat farmers.

"After months of research, planning and brand development exercises we are ready to launch the new PlainsGold brand," said Anderson "It's an exciting time for our organization. CSU continues to develop new and better varieties faster than ever. Now we have a solid platform to increase the sales of these new best-in-class wheat varieties."

All previously developed varieties along with new and future varieties developed by CSU will be marketed and sold under this new brand name. As always, royalties from all PlainsGold varieties will continue to go back the CSU wheat breeding program to further enhance the funding provided by the wheat assessment paid by all Colorado wheat farmers.

Joe Westhoff has been hired as seed and trait specialist for PlainsGold. Joe is a past president of the Colorado Wheat Administrative Committee, the Colorado Association of Wheat Growers, and the Colorado Wheat Research Foundation.

For more information about the new PlainsGold brand and the certified wheat varieties available, please visit: www.plainsgold.com.

How to Calibrate Your Drill to Plant Seeds per Acre

Jerry Johnson and Sally Sauer

There are advantages to planting seeds per acre instead of pounds per acre due to the potentially large difference in seed size among seed lots. It is not uncommon to have some seed lots with 10,000 seeds per pound or 18,000 seeds per pound. A farmer planting 35 pounds per acre could be planting 350,000 seeds per acre or 630,000 seeds per acre depending on the number of seeds per pound. Another advantage of planting seeds per acre is that you know how many seeds were planted per linear foot of row so stand counts can be taken after emergence to determine what percent of planted seed actually emerged. I am surprised that actual stands often turn out to be much lower than expected – even under seemingly good planting conditions. You don't have to know how many seeds per pound of seed to be able to plant seeds per acre.

The following table (see next page) will assist you in calibrating your drill to plant seeds per linear row foot (seeds per acre).

STEP 1: (see table) requires you estimate your percent emergence rate based upon your planting conditions. Emergence rate is not the germination percentage of your seed, but rather what percent of seed planted will actually emerge. I have provided a guideline to help you determine your estimated emergence rate, which ranges from very poor to excellent planting conditions.

STEP 2: (see table) determine desired plant population depending on the date of planting. For example, if planting in early September, you might want 500,000 plants per acre to avoid having too many plants and tillers the next spring that might exhaust available soil moisture.

STEP 3: (see table) is to find the row spacing for your drill and read across to the column you found in STEP 1 to find the number of seeds per linear foot. Set your drill accordingly. Note that drills will need to be recalibrated if planting conditions improve (it rains) or become worse (hot and dry) or if your planting season is extended to a later date requiring a heavier seeding rate.

We are interested in your experience. Send Sally and/or myself an email message or feel free to call either of us with comments or questions.

Jerry Johnson (970) 491-1454 or Jerry.Johnson@colostate.edu

Sally Sauer (970) 491-1914 or Sally.Sauer@colostate.edu

Planting Rate in Seeds Per Linear Foot of Row

			Step 1: Planting Conditions and Farmer Estimated Emergence Rate					
	Step 2:	***Step 3:***	Very Poor	Poor		Average	Excellent	
Seeding Date	Desired Plant Population	Row Spacing	40%	50%	60%	70%	80%	90%
	plants/acre	inches	seeds/linear foot of row					
Late Aug.	300,000	6.0	9	7	6	5	4	4
	300,000	7.5	11	9	7	6	5	5
	300,000	10.0	14	11	10	8	7	6
	300,000	12.0	17	14	11	10	9	8
Early Sept.	500,000	6.0	14	11	10	8	7	6
	500,000	7.5	18	14	12	10	9	8
	500,000	10.0	24	19	16	14	12	11
	500,000	12.0	29	23	19	16	14	13
Mid-Sept.	700,000	6.0	20	16	13	11	10	9
	700,000	7.5	25	20	17	14	13	11
	700,000	10.0	33	27	22	19	17	15
	700,000	12.0	40	32	27	23	20	18
Late Sept./Early Oct.	900,000	6.0	26	21	17	15	13	11
	900,000	7.5	32	26	22	18	16	14
	900,000	10.0	43	34	29	25	22	19
	900,000	12.0	52	41	34	30	26	23
Mid/Late Oct.	1,100,000	6.0	32	25	21	18	16	14
	1,100,000	7.5	39	32	26	23	20	18
	1,100,000	10.0	53	42	35	30	26	23
	1,100,000	12.0	63	51	42	36	32	28

Wheat Pest Research Progress – 2012

Frank Peairs
Department of Bioagricultural Sciences and Pest Management

Brown wheat mite

Brown wheat mite traditionally has been a sporadic pest of wheat, with widespread damage limited to periods of drought. For unknown reasons, possibly due to changes in production practices, this pest has become a more consistent and widespread problem over the past few years. Research priorities include mass rearing, infestation methods, host range and resistance screening techniques.

Brown wheat mite performance on seven cool season grasses and winter wheat was evaluated by Sheri Hessler, a graduate student in our department. Downy brome and intermediate wheatgrass were similar to winter wheat, while the others were inferior hosts. Field studies of reinfestation of winter wheat from noncultivated hosts support these results. Such studies improve our knowledge of brown wheat mite field ecology as well as our techniques for plant infestation and damage evaluation, which will be necessary for screening for resistance once mass rearing methods have been developed.

Ms. Hessler also is addressing the problem of egg dormancy, using two approaches. The first is to manipulate the egg environment to get dormant eggs to hatch prematurely. Many insects and mites use photoperiod (relative length of day and night) as an environmental cue for life history events such as breaking dormancy. We have found that interrupting the night with brief periods of light does hasten egg hatch, although the viability of the prematurely hatched eggs is reduced compared to those that went through a complete dormant period. The other approach is to prevent eggs from going dormant in the first place. We also are evaluating photoperiod as a means to accomplish this. Less progress has been made with the second approach. Photoperiod manipulation seems to be the key to breaking or preventing egg dormancy, however, much needs to be learned before we are able to efficiently mass rear brown wheat mite for plant resistance screening and other studies.

A treatment timing study again showed effectiveness of early treatment of brown wheat mite in terms of reducing mite abundance. However, yield differences were not observed. It is very difficult to measure insect and mite effects on yield unless the level and uniformity of the infestation can be controlled. This is another example of our need to be able to efficiently mass produce brown wheat mites.

Russian wheat aphid

We have found Russian wheat aphids on noncultivated grasses in montane environments throughout the past several growing seasons. We currently are biotyping 80 clones collected from higher elevations as well as from eastern Colorado locations. Early indications are that there is more biotypic diversity among the high elevation collections, but this needs to be confirmed. Russian wheat aphid biotypes are a serious problem for the wheat breeding program. We are trying to determine the origin of new biotypes, and it seems likely that montane environments may be one important source.

Exclusion cage studies were conducted to determine if the effectiveness of biological control of Russian wheat aphid has changed over the last fifteen years. The results from three years of observations confirm that several natural enemies have adapted to Russian wheat aphid as a food source, and that biological control has become a much more important factor in controlling outbreaks.

We are in our second year of evaluating the effectiveness of resistance varieties with the Dn7 source of resistance against Russian wheat aphid biotype RWA2. Results from the first year indicated that this source provides highly effective resistance against this biotype.

Wheat stem sawfly

The wheat stem sawfly, Cephus cinctus Norton, long considered a severe pest of wheat in Montana, North Dakota and the Prairie Provinces, was found damaging winter wheat along Highway 14 in Weld County, CO in 2010 and 2011. It is unknown how far into Colorado the problem will spread.

Since the beginning of the last century the sawfly has spread south out of Canada into the northern Great Plains spring wheat. In the last three decades, it has become more abundant on winter wheat and damage to winter wheat has spread into southeastern Wyoming and the Nebraska Panhandle. The sawfly attacks both spring and winter wheat varieties, causing substantial yield loss due to lodging and reduced seed yield. Estimated annual losses in Montana average $25 million.

We plan to survey eastern Colorado wheat over the next three years to determine the distribution and rate of spread of the infestation. This information will be used to help the wheat breeding program prioritize this issue among the many important breeding objectives it is trying to meet.

In addition, we will evaluate chemical control and some promising sawfly-resistant (solid stem) varieties from Montana. Finally, we will be monitoring the sawfly at several locations in the New Raymer area to get a better understanding of its field biology under Colorado conditions.

SOIL

Fertilizing Winter Wheat no. 0.544

by J.G. Davis and D.G. Westfall [1] (5/09)

Quick Facts...

Nitrogen is the most limiting nutrient for winter wheat production.

Apply nitrogen fertilizers at rates based on expected crop yields minus credits for residual soil nitrates and nitrogen mineralized from organic matter, manure, and previous legume crops.

Apply phosphate fertilizers at rates based on soil test results. Band applications are more effective than broadcast applications.

Most Colorado soils contain sufficient available potassium for dryland winter wheat production.

Colorado State University

Extension

Adequate soil fertility is one of the requirements for profitable winter wheat production. Nitrogen (N) is the most yield-limiting nutrient. Phosphorus (P) is the next most limiting nutrient, and sulfur (S) may be limiting in rare situations on some soils. Levels of potassium (K) and micronutrients generally are sufficient for wheat production in Colorado soils.

Soil Sampling

The value of a soil test in predicting nutrient availability during the growing season depends on how well the sample collected represents the area sampled. Take surface samples from the tillage layer (4 to 8 inches) or the 1-foot soil depth. Take subsoil samples to a depth of 2 feet for determination of available NO_3-N. If the field has been in no-till, reduce the sampling depth to the tillage layer.

A good sample is a composite of 15 to 20 soil cores taken from an area uniform in soil type. This number of soil cores is especially important in sampling fields where P fertilizers were band applied in previous years. Sample areas with major differences in soil properties or management practices separately.

Thoroughly air dry all soil samples within 12 hours after sampling by spreading the soil on any clean surface where the soil will not be contaminated. **Do not oven dry the soil** because this can change the soil test results. Place the air-dried soil in a clean sample container for shipment to the soil test laboratory.

Submit a carefully completed information form with the soil sample. This form provides information so fertilizer suggestions can be tailored to your specific situation. Take soil samples for NO_3-N analysis every year for optimum N fertilization of crops. Soil analyses for availability of the other nutrients, pH, and organic matter content may be sufficient every three to four years.

For more detailed explanations of the importance of taking proper soil samples contact the Colorado State University Soil, Water, and Plant Testing Laboratory in Room A319, Natural and Environmental Sciences Building, Colorado State University, Fort Collins, CO 80523; (970) 491-5061; http://www.extsoilcrop.colostate.edu/SoilLab//soillab.html.

Nitrogen Suggestions

Base nitrogen rates for winter wheat on the expected yields for each field. Nearly all wheat requires some N fertilizer, unless there is a substantial release of available N in the soil prior to planting.

Other credits for N include the amounts expected to become available during the season from mineralization of soil organic matter, manure and previous legume crops. Subtract these credits from the total crop needs to determine the suggested N fertilizer rate for the expected yield.

Table 1: Suggested N rates for dryland winter wheat, as related to NO_3-N in the soil and soil organic matter content (expected yield, 50 bu/A).

ppm NO_3-N in soil*		Soil organic matter, %		
0 - 1 ft	0 - 2 ft	0 - 1.0	1.1 - 2.0	>2.0
		---Fertilizer rate, lb N/A----		
0 - 3	0 - 5	75	75	75
4 - 6	6 - 9	75	70	50
7 - 9	10 - 12	75	45	25
10 - 12	13 - 15	50	20	0
13 - 15	15 - 18	25	0	0
> 15	> 18	0	0	0

* Concentration of NO_3-N in the top foot of soil or the sum of NO_3-N concentrations in 1-foot sample depths to 2 feet.
- To adjust N rate for expected yields different from 50 bu/A, add or subtract 25 lb N/A for each 10 bu/A difference (maximum N rate is 75 lb/A for dryland winter wheat).

Table 2: Suggested nitrogen rates for irrigated winter wheat, as related to NO_3-N in the soil and soil organic matter content (expected yield, 100 bu/A).

ppm NO_3-N in soil*	Soil organic matter, %		
	0 - 1.0	1.1 - 2.0	>2.0
0 - 6	125	95	75
7 - 12	105	75	55
13 - 18	85	55	35
19 - 24	65	35	15
25 - 30	45	15	0
31 - 36	25	0	0
> 36	0	0	0

* Sum of ppm NO_3-N in 1-foot sample depths to 2 feet (for sample depths of 1 foot only, multiply the ppm value by 1.67 before using the table).
-To adjust N rate for expected yields different from 100 bu/A, add or subtract 20 lb N/A for each 10 bu/A difference.
NOTE: Increase the above rates by 40 lb N/A for irrigated wheat in Alamosa, Conejos, Costilla, Rio Grande and Saguache counties.

Soil Nitrate-N Credit

Residual NO_3-N in soil is immediately available to plants, so decrease the fertilizer rate to give credit for the amount of NO_3 in the root zone. Sample soil to a depth of 2 feet in 1-foot increments and test for NO_3-N. The sum of the ppm values for the two samples is used to estimate the NO_3-N content in the soil. For example, if the NO_3-N contents of the 0-1 and 1-2 foot soil samples are 10 and 4 ppm, use the N rates in the 13 to 15 ppm row in the second column of Table 1. When soil is sampled to a 1-foot depth, use the first column in Table 1.

Soil Organic Matter Credit

Nitrogen in soil organic matter becomes available to plants through the mineralization process. About 30 pounds of nitrogen per acre will be available to the crop during each growing season for each 1.0 percent organic matter in the surface soil layer. When a soil test result for organic matter is not available, assume a level of 1.5 percent organic matter for eastern Colorado soils.

Dryland Wheat

Suggested N rates for dryland wheat are given in Table 1 at an expected yield of 50 bushels per acre. Fertilizer N rates decrease with increasing levels of NO_3-N in the top foot or 2 feet of soil or increasing soil organic matter content. Suggested N rates in this table do not account for manure and legume N credits. Subtract these credits from the N rates in Table 1 to determine the N rate for the field.

To increase grain protein content to above average levels (i.e., >12 percent protein), increase the N rate. It takes 20 to 30 pounds of nitrogen per acre to increase grain protein by one percentage point above 12 percent protein.

Irrigated Wheat

Table 2 gives suggested N rates for irrigated wheat at an expected yield of 100 bushels per acre. Fertilizer N rates decrease with increasing levels of NO_3-N in the top 2 feet of soil or increasing soil organic matter content. Suggested N rates in this table do not account for manure and legume N credits. Subtract these credits from the N rates in Table 2 to determine the N rate for the field. Late season N applications are not suggested for soft wheat because a lower protein content is desired.

Methods and Timing of N Applications

Nitrogen fertilizer may be applied by various methods. Most efficient use of fertilizer N can be obtained by applying some of the N prior to or at planting and the remainder in the early spring. Some growers prefer to apply anhydrous ammonia in combination with P fertilizers in a tillage operation during the fallow period for dryland wheat. Some N may be applied with or near the seed in combination with P in starter fertilizers, but the rate should be less than 20 pounds of N per acre because seedling emergence may be decreased in dry soil at higher rates. All sources of N fertilizers are equally effective for wheat per unit of N if properly applied. Base your choice of N on availability, equipment needs, and cost per unit of N.

Topdressing N fertilizers in the spring is an efficient way to supply a portion of the total N needs of wheat. Producers can evaluate spring-stored moisture and plant populations to better predict yield potential in the spring than at planting, so N needs by the crop can be better determined. Granular fertilizer can be broadcast on the wheat just after greenup. Fluid N solutions also may be dribble-applied to the wheat crop, although there is some potential for leaf burn.

Placement of P fertilizers in the root zone is important because P is not very mobile in soil.

Apply nitrogen fertilizers through sprinkler irrigation systems for irrigated wheat. All closed-irrigation systems must be equipped with backflow prevention valves if N fertilizers are applied through the system.

There is a strong relationship between protein content of wheat and the N fertility status of a given field. Fields that produce grain with protein content with less than 11 percent are likely to have N deficiencies. Those fields that produce grain with protein between 11 and 12 percent may respond to additional N fertilizer, while those that produce grain with more than 12 percent protein probably have adequate N for the present grain yield levels. Therefore, protein analysis of wheat will give the producer a good indication if the N fertilizer program was adequate for that season.

This information can be used to help plan N fertilizer management in future years. The above relationships do not hold well under extreme drought conditions. Field conditions also should be considered. For more information, see 0.555, *Grain Protein Content and N Needs*.

Phosphorus Suggestions

Crop responses to P fertilizer are most likely on soils with low or medium levels of extractable P. Suggested P fertilizer rates (Table 3) are for band (or row) application and are similar for dryland and irrigated wheat. The main soil tests for extractable P in Colorado soils are the AB-DTPA and sodium bicarbonate ($NaHCO_3$ also known as Olsen) tests. Values for both tests are given in Table 3.

Placement of P fertilizers in the root zone is important because P is not very mobile in soil. Band application of starter fertilizers with or near the seed is the most efficient placement method for P, and suggested rates for broadcast application are about double those for band application. Incorporate broadcast applications of P fertilizers into the soil prior to planting.

Table 3: Suggested phosphorus rates for band application to dryland and irrigated winter wheat.

ppm P in soil		Relative	Fertilizer rate,
AB-DTPA	$NaHCO_3$	level	lb P_2O_5/A
0 - 3	0 - 6	low	40
4 - 7	7 - 14	medium	20
> 7	> 14	high	0

Dual application of N and P together in a band improves efficiency of P uptake by crops. Subsurface placement of P may be especially important for reduced tillage cropping systems. Monoammonium phosphate (MAP, 11-52-0), diammonium phosphate (DAP, 18-46-0), and ammonium polyphosphate (10-34-0) are equally effective per unit of P if properly applied. Base choice of fertilizer product on availability, equipment needs, and cost per unit of P.

An effective method of band application of P with hoe drills allows the P fertilizer to be banded on the soil surface directly above the seed row after row closure.

Potassium Suggestions

Most Colorado soils are relatively high in extractable K, and few crop responses to K fertilizers have been reported. Suggested K rates related to soil test values (AB-DTPA or NH_4OAc) are similar for dryland and irrigated wheat (Table 4). The main K fertilizer is KCl (muriate of potash). Broadcast application incorporated into the soil prior to planting is the usual method.

Other Nutrients

Most Colorado soils contain adequate levels of available S, and soil tests for available S are not routinely performed. Under rare situations some sandy soils may require S applications; the chances of getting a yield response to S fertilization increase when the soil pH is 7.5 or higher and the soil organic matter content is 1.5 percent or lower. Irrigation water from most surface waters and some wells often contains appreciable SO_4-S, so irrigated soils usually are adequately supplied with S.

There have been no confirmed deficiencies of boron (B), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), zinc (Zn), or chloride (Cl) in wheat in Colorado.

Table 4: Suggested potassium rates for dryland and irrigated winter wheat.

ppm K in soil AB-DTPA or NH_4OAc	Relative level	Fertilizer rate, lb K_2O/A
0 - 60	low	30
> 60	high	0

[1]J.G. Davis, Colorado State University Extension soils specialist and professor, and D. G. Westfall, professor; soil and crop sciences. Original authors included; J. J. Mortvedt, soils specialist, and J.F. Shanahan, Extension crop specialist and professor.

Managing Stripe Rust with Fungicides

Ned Tisserat

Stripe rust has become a serious problem for wheat producers in Colorado. Prior to1999, stripe rust was largely confined to the Pacific Northwest but a new race of the pathogen was found in the Great Plains around that time and it was more adapted to our spring weather patterns. Since then, we have experienced a number of stripe rust outbreaks. Fortunately, stripe rust resistance genes were already present or were bred into many popular wheat varieties. However, new races of stripe rust emerged in 2010 and again in 2012 and many varieties that were resistant are now susceptible. Farmers should refer to the *Description of Winter Wheat Varieties in Eastern Colorado Trials* for updated information on variety susceptibility. It is not possible to forecast which stripe rust races will predominate in a given year, so varieties rated as moderately susceptible to susceptible should be considered at risk.

A management strategy for stripe rust-susceptible varieties is fungicide use. Many different fungicides are labeled for stripe rust control and they provide very good to excellent control when applied prior to infection. Consult the *North Central Regional Committee on Management of Small Grain Diseases* (NCERA-184) fungicide efficacy chart below for details on these fungicides. The fungicides belong to one of two classes based on mode of action; the triazoles and the strobilurins. Some fungicides are mixtures of these two products.

Fungicides have their greatest efficacy if they are applied two to three weeks or less before infection. In Colorado, rust infections typically start to develop around the time the flag leaf emerges. If stripe rust is present in the region, this is good time to make an application. Earlier applications (i.e. at jointing) are not warranted if stripe rust has not yet made it to Colorado. In fact these very early sprays will not prevent stripe rust development during flowering or grain filling because there is little fungicide residual left in the plant. The rule of thumb is to wait as long as possible before making an application, but not so long that a high level of infection has already occurred. Also remember there are harvest restrictions for these fungicides that limit their application after flowering or 30 days before harvest.

There are many factors in addition to varietal resistance/susceptibility to consider before making fungicide applications. They include the presence of the disease in the region (for inoculum), a weather forecast that is favorable for disease development, market prices, expected yield levels, and fungicide and application costs. In collaboration with colleagues throughout the nation, we monitor stripe rust development each spring and provide periodic reports on the potential for damage in Colorado via email to producers. Email Ned Tisserat (Ned.Tisserat@colostate.edu) to receive the report updates.

Management of Small Grain Diseases
Fungicide Efficacy for Control of Wheat Diseases (Revised 4-17-12)

The North Central Regional Committee on Management of Small Grain Diseases (NCERA-184) has developed the following information on fungicide efficacy for control of certain foliar diseases of wheat for use by the grain production industry in the U.S. Efficacy ratings for each fungicide listed in the table were determined by field testing the materials over multiple years and locations by the members of the committee. Efficacy is based on proper application timing to achieve optimum effectiveness of the fungicide as determined by labeled instructions and overall level of disease in the field at the time of application. Differences in efficacy among fungicide products were determined by direct comparisons among products in field tests and are based on a single application of the labeled rate as listed in the table. The table includes the most widely marketed products, and is not intended to be a list of all labeled products.

Efficacy of fungicides for wheat disease control based on appropriate application timing

Fungicide(s)												
Class	**Active ingredient**	**Product**	**Rate/A (fl. oz)**	**Powdery mildew**	**Stagonospora leaf/glume blotch**	**Septoria leaf blotch**	**Tan spot**	**Stripe rust**	**Leaf rust**	**Stem rust**	**Head scab**	**Harvest Restriction**
Strobilurin	**Fluoxastrobin 40.3%**	**Evito 480 SC**	**2.0 – 4.0**	G	--[3]	--[3]	VG	--[3]	VG	--[3]	NL	40 days
	Pyraclostrobin 23.6%	**Headline SC**	**6.0 - 9.0**	G	VG	VG	E	E[2]	E	G	NL	Feekes 10.5
Triazole	**Metconazole 8.6%**	**Caramba 0.75 SL**	**10.0 - 17.0**	VG	VG	--[3]	VG	E	E	E	G	30 days
	Propiconazole 41.8%	**Tilt 3.6 EC[4]**	**4.0**	VG	VG	VG	VG	VG	VG	VG	P	Feekes 10.5
	Prothioconazole 41%	**Proline 480 SC**	**5.0 - 5.7**	--[3]	VG	VG	VG	--[3]	VG	VG	G	30 days
	Tebuconazole 38.7%	**Folicur 3.6 F[4]**	**4.0**	G	VG	VG	VG	E	E	E	F	30 days
	Prothioconazole19% Tebuconazole 19%	**Prosaro 421 SC**	**6.5 - 8.2**	G	VG	VG	VG	E	E	E	G	30 days
Mixed mode of action	**Metconazole 7.4% Pyraclostrobin 12%**	**TwinLine 1.75 EC**	**7.0 – 9.0**	G	VG	VG	E	E	E	VG	NL	Feekes 10.5 and 30 days
	Propiconazole 11.7% Azoxystrobin 7.0%	**Quilt 200 SC**	**14.0**	VG	VG	VG	VG	E	E	VG	NL	Feekes 10.5
	Propiconazole 11.7% Azoxystrobin 13.5%	**Quilt Xcel 2.2 SE**	**10.5 - 14.0**	VG	VG	VG	VG	E	E	VG	NL	Feekes 10.5
	Propiconazole 11.4% Trifloxystrobin 11.4%	**Stratego 250 EC**	**10.0**	G	VG	VG	VG	VG	VG	VG	NL	35 days
	Prothioconazole 10.8% Trifloxystrobin 32.3%	**Stratego YLD**	**4.0**	G	VG	VG	VG	VG	E	VG	NL	35 days
	Tebuconazole 22.6% Trifloxystrobin 22.6%	**Absolute 500 SC**	**5.0**	G	VG	VG	VG	VG	E	VG	NL	35 days

[1] Efficacy categories: NL=Not Labeled and Not Recommended; P=Poor; F=Fair; G=Good; VG=Very Good; E=Excellent.
[2] Efficacy may be significantly reduced if solo strobilurin products are applied after stripe rust infection has occurred
[3] Insufficient data to make statement about efficacy of this product
[4] Multiple generic products containing the active ingredients propiconazole and tebuconazole may also be labeled in some states. Products including tebuconazole incude: Embrace, Monsoon, Muscle 3.6 F, Onset, Orius 3.6 F, Tebucon 3.6 F, Tebustar 3.6 F, Tebuzol 3.6 F, Tegrol , and Toledo. Products containing propiconazole include: Bumper 41.8 EC, Fitness, Propiconazole E-AG, and PropiMax 3.6 EC.

This information is provided only as a guide. It is the responsibility of the pesticide applicator by law to read and follow all current label directions. No endorsement is intended for products listed, nor is criticism meant for products not listed. Members or participants in the NCERA-184 committee assume no liability resulting from the use of these products.

Winter Wheat Weed Management – 2012-2013

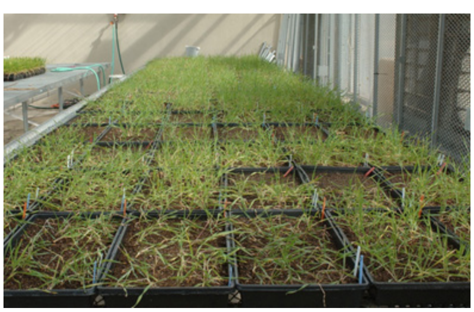
Philip Westra, CSU Professor of Weed Science

Kochia. The CSU weed science program continues to receive scattered but increasing reports of kochia no longer controlled by field rates of glyphosate. Some speculate that the problem may be due to cut rate glyphosate applications, improper use of recommended additives or surfactants, or even that generic glyphosate use has had an impact on variable weed control. Regardless of your favorite theory regarding the source of the problem, CSU research in consort with KSU has shown over the past 3 years that glyphosate resistant kochia is real, and that the problem is slowly spreading. Part of this spread is aided by the tumbleweed nature of kochia which drops seeds as it blows in the wind.

Although most samples tested at the CSU weed lab exhibit kochia segregation for the glyphosate resistance trait, many suspect samples contain plants that survive glyphosate rates several times higher than the recommended field rate. Such populations are likely to evolve into populations of pure glyphosate resistant plants unless other means are used to kill these plants. Our graduate students have determined the mechanism of glyphosate resistance in kochia, and the news is not good. It suggests that kochia really could become the Palmer amaranth of the western US and Canada. To date, there are confirmed resistant populations from KS, CO, NE, SD, ND, MT, and western Alberta in Canada.

Green glyphosate resistant plants (background) in the greenhouse.

Kochia has a short seed life, but new seed can arrive via plants that blow in from neighboring fields. Many alternative herbicides are being evaluated for kochia control both in fallow and in various crops. Products such as dicamba, fluroxypyr, Huskie®, Laudis®, paraquat, linuron, and atrazine can provide good control. Several soil applied herbicides can also help control kochia, but most are crop specific. Zidua®, a new corn herbicide, appears to have good pre-emerge activity on kochia when activated with some moisture. As we continue to evaluate new strategies to deal with these resistant populations, it is becoming clear that kochia management in Colorado will be more complicated and perhaps more costly in the future. CSU weed science will be working on this issue for the next 5 years.



CSU greenhouse research with feral rye and Beyond herbicide.

Feral rye in winter wheat. The CSU weed science program recently initiated a new research project to better understand the factors that sometimes cause variable rye control in Clearfield wheat with Beyond herbicide. Things such as temperatures before and after Beyond treatment, plus the potential use of more effective adjuvants in the new two-gene wheats such as Brawl CL Plus are being evaluated. In addition, we have collected 111 feral rye seed samples from georeferenced locations throughout eastern Colorado this summer. We will be evaluating these diverse feral rye populations for their response to different rates of Beyond herbicide. Our long term goal is to improve the reliability of feral rye control under highly variable winter wheat growing conditions.

CWRF ConAgra Mills Ultragrain® Premium Program Adds Seed Rebate and Makes It Easier for Farmers to Earn Protein Premium

Glenda Mostek

The Colorado Wheat Research Foundation (CWRF) and ConAgra Mills have announced a $2 per bushel seed rebate and easier-to-reach protein targets for the CWRF ConAgra Mills Ultragrain Premium Program for hard white wheat. Farmers who purchase Snowmass or Thunder CL this fall from a participating seed grower will get a $2 per bushel rebate on their certified seed purchase from ConAgra Mills. The rebate applies to this year's seed purchases but will be paid after next year's harvest.

Growers who participate in the program gain a minimum base premium of 30 cents per bushel for the 2012 crop, plus a protein premium of up to 60¢ per bushel for wheat with 15 percent protein for a total premium of 90¢. The maximum protein premium will remain at 90¢ per bushel; however, premiums will increase faster at lower protein levels. For each 0.2 percent of protein greater than 12 percent, farmers will receive 3¢, with an additional 5¢ per bushel at 12.6 percent protein (14¢), 10¢ per bushel at 13.0 percent protein (25¢), and 15¢ per bushel at 13.4 percent protein (36¢) (see protein scale on the next page).

Two hard white wheat varieties are eligible for the CWRF ConAgra Mills Ultragrain Premium Program: Snowmass and Thunder CL. They are both marketed under the PlainsGold brand name. Snowmass is a hard white winter wheat variety which combines good dryland yields and drought stress tolerance with good test weights, excellent wheat streak mosaic virus resistance, and superior milling and baking quality characteristics. The second variety eligible for the program is Thunder CL, a Clearfield hard white winter wheat variety that is tolerant to Beyond™ herbicide for broad-spectrum weed control, including problematic winter annual grassy weeds. In addition, Thunder CL combines good irrigated yields, disease resistance, and test weights, with superior milling and baking qualities. Thunder CL also has excellent straw strength for production under irrigated conditions.

According to a U.S. Wheat Associates survey of export customers, there is an unmet demand for 145 million bushels of hard white wheat for export. Consumer interest in the added nutrition benefits of whole grain foods has also spiked recently. Ultragrain flour is 100-percent whole wheat that combines the nutrition and benefits of whole grains with the finished recipe qualities of refined flour. As Commerce City, Colorado is a key Ultragrain milling location, it offers growers a local market they can count on. Colorado growers can capitalize on the growing demand through the program and secure their positions in the long-term market.

Wheat raised under the CWRF ConAgra Mills Ultragrain Premium Program must be grown under contract, and delivered to one of the following delivery points:

Amherst – Grainland Coop
Anton – Anton Coop
Bennett – Roggen Farmers Elevator Association
Commerce City/Denver – Commerce City Grain
Fort Morgan – Wildcat Dairy
Genoa – Flagler Coop
Haxtun – Grainland Coop
Holyoke – Grainland Coop
Pierce – Roggen Farmers Elevator Association
Stratton – Stratton Equity Coop
Vona – Tempel Grain

Protein Scale

Protein Level	Base Premium	Additional Premium	Total Premium
12.2%	$0.30	$0.03	$0.33
12.4%	$0.30	$0.06	$0.36
12.6%	$0.30	$0.14	$0.44
12.8%	$0.30	$0.17	$0.47
13.0%	$0.30	$0.25	$0.55
13.2%	$0.30	$0.28	$0.58
13.4%	$0.30	$0.36	$0.66
13.6%	$0.30	$0.39	$0.69
13.8%	$0.30	$0.42	$0.72
14.0%	$0.30	$0.45	$0.75
14.2%	$0.30	$0.48	$0.78
14.4%	$0.30	$0.51	$0.81
14.6%	$0.30	$0.54	$0.84
14.8%	$0.30	$0.57	$0.87
15.0%	$0.30	$0.60	$0.90

For more information about the program, or to locate a seed grower in your area, contact CWRF at (970) 449-6994 or visit www.coloradowheat.org or www.plainsgold.com.

Wheat Information Resources

Dr. Jerry Johnson - Associate Professor and Extension Specialist - Crop Production, Colorado State University, Department of Soil and Crop Sciences, C12 Plant Science Building, Fort Collins, CO 80523-1170, Phone: 970-491-1454, E-mail: jerry.johnson@colostate.edu.

Dr. Scott Haley - Professor and Wheat Breeder, Colorado State University, Department of Soil and Crop Sciences, C136 Plant Science Building, Fort Collins, CO 80523-1170, Phone: 970-491-6483, E-mail: scott.haley@colostate.edu.

Dr. Jessica Davis - Professor and Extension Specialist - Soils, Colorado State University, Department of Soil and Crop Sciences, C09 Plant Science Building, Fort Collins, CO 80523-1170, Phone: 970-491-1913, E-mail: jessica.davis@colostate.edu.

Rick Novak - Director of Colorado Seed Programs, Colorado State University, Department of Soil and Crop Sciences, C143 Plant Science Building, Fort Collins, CO 80523, Phone: 970-491-6202, E-mail: rick.novak@colostate.edu.

Darrell Hanavan - Executive Director of the Colorado Wheat Administrative Committee, the Colorado Association of Wheat Growers, and the Colorado Wheat Research Foundation, 4026 South Timberline Road, Suite 100, Fort Collins CO 80525, Phone: 970-449-6994, Toll free: 1-800-WHEAT-10, E-mail: dhanavan@coloradowheat.org.

Dr. Frank Peairs - Professor and Extension Specialist - Entomology, Colorado State University, Department of Bioagricultural Sciences & Pest Management, 102 Insectary, Fort Collins, CO 80523-1177, Phone: 970-491-5945, E-mail: frank.peairs@colostate.edu.

Dr. Ned Tisserat - Professor and Extension Specialist - Plant Pathology, Colorado State University, Department of Bioagricultural Sciences & Pest Management, C137 Plant Science Building, Fort Collins, CO 80523-1177, Phone: 970-491-6527, E-mail: ned.tisserat@colostate.edu.

Thia Walker - Extension Specialist - Pesticide Education, Colorado State University, 1177 Campus Delivery, Fort Collins, CO 80523-1177, Phone: (970) 491-6027, E-mail: thia.walker@colostate.edu.

Dr. Phil Westra - Professor and Extension Specialist - Weed Science, Colorado State University, Department of Bioagricultural Sciences & Pest Management, 112 Weed Research Lab, Fort Collins, CO 80523-1177, Phone: 970-491-5219, E-mail: philip.westra@colostate.edu.

Bruce Bosley - Extension Agronomist, Logan County, 508 South 10th Avenue, Suite 1, Sterling, CO 80751-3408, Phone: 970-522-3200, E-mail: bruce.bosley@colostate.edu.

Dr. Wilma Trujillo - Extension Agronomist, Prowers County, 1001 South Main Street, Lamar, CO 81052-3838, Phone: 719-336-7734, E-mail: wilma.trujillo@colostate.edu.

Ron Meyer - Extension Agronomist, Kit Carson County, 251 16th Street, Suite 101, Burlington, CO 80807-1674, Phone: 719-346-5571 Ext. 302, E-mail: rf.meyer@colostate.edu.

Additional Wheat Information Resources on the Web

http://www.csucrops.com - Colorado State University Crop Variety Testing Program
http://wheat.colostate.edu - Colorado State University Wheat Breeding Program
http://wheat.colostate.edu/vpt.html - Colorado Wheat Variety Performance Database (CSU Wheat Breeding Program).
http://www.coloradowheat.org - Colorado Wheat Administrative Committee (CWAC), Colorado Association of Wheat Growers (CAWG), and Colorado Wheat Research Foundation (CWRF) website.

Acknowledgments

The authors are grateful for support received from Colorado State University and for the funding received from the Colorado Wheat Administrative Committee and the Colorado Wheat Research Foundation. The Colorado Wheat Administrative Committee provides substantial financial support to Colorado State University for wheat breeding and wheat-related research. We are thankful to Kierra Jewell (CSU Extension); Jim Hain (Crops Testing); John Stromberger, Emily Hudson, Rebecca Kottke, Scott Seifert, Victoria Valdez, and Marc Moragues (Wheat Breeding Program); Chris Fryrear, Mark Collins, and Bob Bee (Agricultural Research, Development and Education Center, Fort Collins); Merle Vigil, Dave Poss, Delbert Koch, and Paul Campbell (USDA-ARS Central Great Plains Research Center, Akron); Deb Harn and Brett Pettinger (Plainsman Research Center, Walsh); Jeff Davidson (Arkansas Valley Research Center, Rocky Ford); and Jeff Rudolph, Thia Walker, Terri Randolph (Russian Wheat Aphid Program), for their work and collaboration that make these trials and this report possible.

The authors are thankful for the cooperation and unselfish contributions of land, labor and equipment made by the following Colorado wheat farmers who consent to having winter wheat variety performance trials conducted on their farms: John and Jensen Stulp (Lamar, Prowers County), Burl Scherler (Brandon, Kiowa County), Dennis and Matt Campbell (Arapahoe, Cheyenne County), Randy Wilks (Burlington, Kit Carson County), Jim Carlson (Julesburg, Sedgwick County), Steve Meakins (Haxtun, Phillips County), Cooksey Farms (Roggen, Weld County), Ross Hansen (Genoa, Lincoln County), Cary Wickstrom (Orchard, Morgan County), and Bill and Steve Andrews (Yuma, Yuma County). We recognize valuable assistance provided by the CSU Extension agents who work with eastern Colorado wheat producers in all aspects of the COFT program.

We are also very thankful for the efforts and sacrifices made by Colorado wheat producers who contributed time, land, and equipment to the success of the Collaborative On-Farm Test program.

Colorado State University is grateful to the Colorado Wheat Administrative Committee for printing this report.

Colorado State University

Crops Testing

Colorado State University

Department of Soil and Crop Sciences
1170 Campus Delivery
Fort Collins, Colorado 80523-1170

Extension

Jerry Johnson, Extension Specialist Crop Production