Technical Report - TR25-2

COLORADO STATE UNIVERSITY

Agricultural Experiment Station

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

2025

2024 WINTER WHEAT VARIETY PERFORMANCE TRIALS

Making Better Decisions

CROPS TESTING PROGRAM

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Additional Resources

Colorado State University Crop Variety Testing Program: www.csucrops.org and on

X (formerly Twitter) with the handle @CSUCrops

Colorado State University Wheat Breeding Program: www.agsci.colostate.edu/wheat/

Wheat Variety Performance Database: www.wheattrials.com

Colorado Wheat Administrative Committee (CWAC), Colorado Association of Wheat Growers (CAWG), and Colorado Wheat Research Foundation (CWRF): www.coloradowheat.org

Overview of 2023-2024 Eastern Colorado Winter Wheat Trials

Sally Jones-Diamond

Colorado State University researchers strive to provide current, reliable, and unbiased wheat variety information to Colorado producers. Support of our research keeps public variety testing thriving in Colorado. Our work is possible due to the support and cooperation of the entire Colorado wheat industry, the Colorado Wheat Administrative Committee, the Colorado Wheat Research Foundation, seed companies who enter varieties, and farmers who donate their land and time to host the replicated wheat variety trials.

The eastern Colorado winter wheat trials are conducted under a broad range of environmental conditions to best determine the expected performance of new and common varieties. We have a regional uniform variety testing program, meaning the dryland varieties entered in our northeast region are tested across seven test locations in Northeast Colorado, and varieties entered in the southeast region are tested across six test locations in Southeast Colorado. All irrigated varieties are tested in three irrigated trials spread across Northeast Colorado. In the dryland trials, there were 50 total varieties tested, including experimental lines across the two regions of the 13 total trial locations. The three irrigated trials had 24 varieties. The variety trials included a combination of public and private varieties and experimental lines. Seed companies with entries in the variety trials included AgriPro Syngenta, CROPLAN by WinField United, Limagrain Cereal Seeds, and Frenchman Valley Coop. There were entries from the marketing organizations of Colorado State University (PlainsGold), Kansas State University (Kansas Wheat Alliance), University of Nebraska-Lincoln (NU Horizon Genetics), Oklahoma State University (Oklahoma Genetics), and the Crop Research Foundation of Wyoming.

All dryland and irrigated trials were planted in a randomized complete block design with three replicates. Plot sizes were approximately 150 ft^2 except the Fort Collins irrigated trial, which was 80 ft^2. All varieties were planted at 700,000 seeds per acre for dryland trials and 2 million seeds per acre for irrigated trials except Fort Collins, which was planted at 1.2 million seeds per acre. Individual location management data is listed in the 2024 Wheat Trial Management and Characteristics table in this report. Grain yield and protein was corrected to 12% moisture content. Variety trial grain weight, test weight, and grain moisture content information were obtained from a HarvestMaster H2 GrainGage™ weigh system on a modified Case IH plot combine. Protein content was obtained using a FOSS Infratec™ NOVA grain analyzer. All trials are statistically analyzed using a spatial mixed model with the best fit for each location using SAS 9.4.

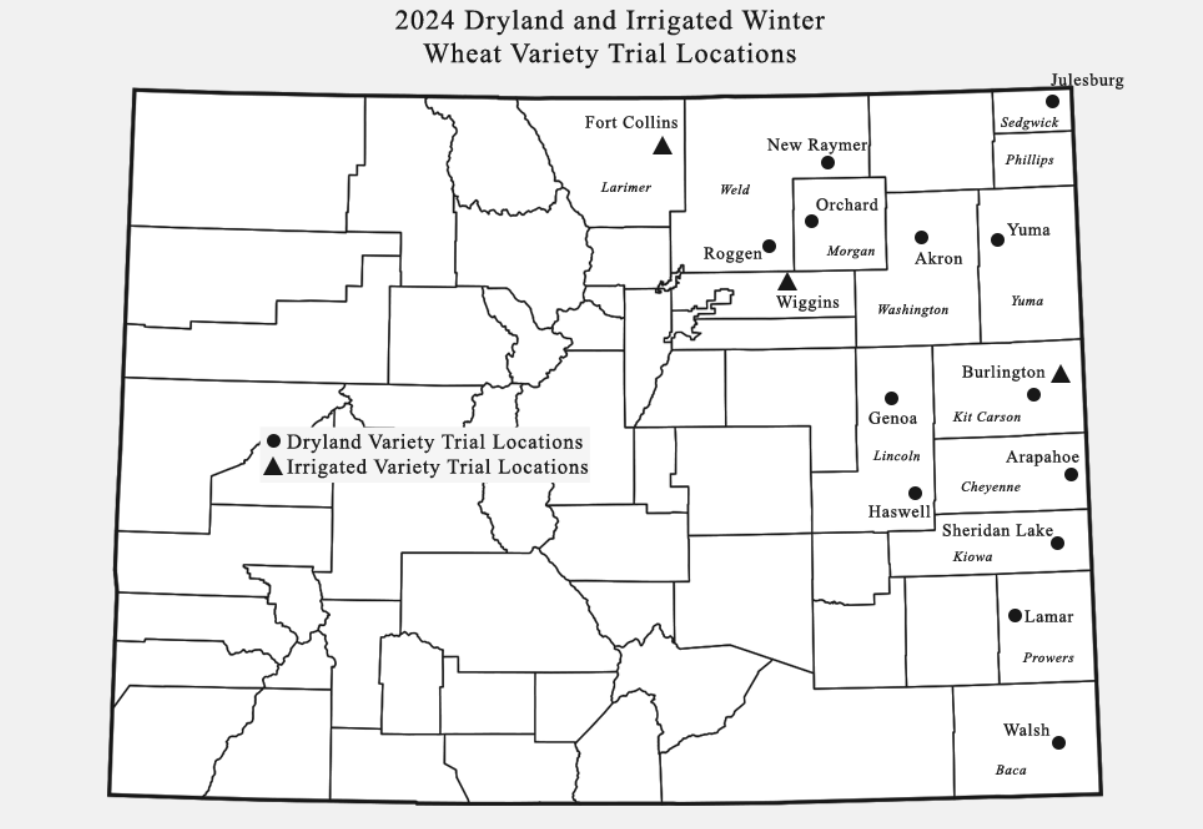
General Growing Conditions Affecting the 2024 Colorado Wheat Crop

Wheat planting conditions in fall of 2023 were average for the region, although some areas had a short window for planting in adequate moisture. During early stand establishment, what started as a few abnormally dry pockets along the eastern border

of Colorado led to widespread drought everywhere but Baca County by late November. Consistent winter precipitation diminished drought conditions across the majority of eastern Colorado. By early April, southeastern Colorado, including Cheyenne, Kiowa, Prowers, and Baca counties, was abnormally dry and experiencing a moderate drought, which persisted through June. Northeast Colorado received timely and frequent rainfall throughout the spring, lasting until harvest, preventing drought conditions. Parts of Adams and Weld counties were abnormally dry from May through harvest (UNL Drought Monitor). Isolated hail events either destroyed or severely damaged wheat fields for a number of producers, especially in Washington and Yuma counties in late May.

Stripe rust disease was not an issue until June, when frequent precipitation and high humidity favored the spread of the disease along the I-70 corridor. Many growers sprayed fungicides if the crop was not yet in the grain-fill period. Brown wheat mites were observed at moderate levels in east-central Colorado in the early spring, while higher levels that required chemical control were noted in southeast Colorado. Cutworms were widespread in northeast Colorado at varying levels of infestation. Wheat Stem Sawfly (WSS) is widespread across many northeast Colorado counties and continues to spread south and east.

Harvest occurred about 2 weeks earlier than normal in Colorado this year due to warmer than average temperatures in late winter and early spring. Wheat yields were mostly above average and test weights were generally very good across the state.



2024 Wheat Trial Management and Characteristics

		Dryland Locations													Irrigated Locations		
		Akron	**Arapahoe**	**Burlington**	**Genoa**	**Haswell**	**Julesburg**	**Lamar**	**New Raymer**	**Orchard**	**Roggen**	**Sheridan Lake**	**Walsh**	**Yuma**	**Burlington**	**Fort Collins**	**Wiggins**
	Average Yield (bu/ac)	90	Lost to Poor Stands	Lost to Poor Stands	Lost to Poor Stands	Lost to Drought	63	43	Lost to Poor Stands	56	Lost to Poor Stands	37	39	Lost to Hail	89	117	151
Location	**GPS Coordinates (Lat/Long)**	40.14928, -103.14352	38.90997, -102.26053	39.30252, -102.29688	39.35565, -103.49227	38.63859, -103.26592	40.85231, -102.38116	38.0034, -102.55723	(40.572458, -103.899)	40.52082, -104.07153	40.08154, -104.30167	38.53114, -102.47207	37.43416, -102.31022	40.19047, -102.66101	39.40977, -102.15246	40.653, -104.99	40.00743, -104.1009
	County	Washington	Cheyenne	Kit Carson	Lincoln	Lincoln	Sedgewick	Prowers	Weld	Morgan	Weld	Kiowa	Baca	Yuma	Kit Carson	Larimer	Adams
Soil	**Soil Type**	Rago silt loam	Wiley complex	Kuma and Keith silt loams	Weld silt loam	Bacid silt loam	Rago and Kuma silt loams	Baca silt loam	Olney fine sandy loam	Ascalon sandy loam	Weld loam	Olney sandy loam	Wiley loam	Platner loam	Kuma-Keith silt loams	Fort Collins loam	Heldt clay loam
	Soil Organic Matter	2.2%	2.1%	1.9%	2.2%	2.1%	1.6%	1.6%	-	1.6%	1.7%	1.6%	-	1.6%	2.9%	-	2.0%
	Soil pH	7.2	8.3	7.8	7.6	7.9	5.8	8.4	-	6.1	7	8.1	-	7.5	7	-	7.9
	Soil Nutrients at planting (N-P lb/ac)	182-17	1-12	104-15	42-16	33-17	92-15	30-17	-	163-21	118-17	3-21	-	84-18	5-13	-	32-10
Management	**Tillage**	No-Till	Tilled	Tilled	Tilled	Tilled	No-Till	Tilled	No-Till	No-Till	No-Till	Tilled	No-Till	No-Till	Tilled	Tilled	Tilled
	Previous Crop	Fallow	Corn	-	-	Sorghum	Corn	Wheat	-	Proso Millet	Fallow	Sorghum	Grain Sorghum	Fallow	Corn	-	Pinto Beans
	Planting Date	9/26/2023	9/19/2023	9/19/2023	9/21/2023	9/8/2023	9/22/2023	9/8/2023	9/22/2023	9/21/2023	9/21/2023	9/7/2023	9/19/2023	9/22/2023	10/9/2023	9/27/2023	10/3/2024
	Harvest Date	7/14/2024	N/A	N/A	N/A	N/A	7/3 & 7/8/2024	6/21/2024	N/A	7/2/2024	N/A	6/25/2024	6/24/2024	N/A	7/9/2024	7/12/2024	7/15/2024
Environment	**Biotic Stress**	Yellowing disease, wheat stem sawfly	N/A	N/A	N/A	N/A	Wheat stem sawfly	brown wheat mite	N/A	Root rot and wheat stem sawfly	N/A	Brown wheat mite	Cutworm	N/A	Wheat stem sawfly	None	Minor wheat stem sawfly
	Abiotic Stress	N/A	Drought	Drought	Drought	Drought	Minor Drought	Drought	Drought	Drought	Drought	Drought	Drought	Hail	Minor Hail	None	None
	Total Rainfall: January 1 to Harvest	10.7"	N/A	N/A	N/A	N/A	9.1"	5.1"	N/A	7.3"	N/A	5.4"	5"	N/A	9.9"	4.7"	8.9"
	Growing Degree-Days (Jan 1 - Harvest, 32°F base)	3,854	N/A	N/A	N/A	N/A	3,451	3,683	N/A	3,253	N/A	3,767	3,990	N/A	3,745	3,461	3,954
	General Comments	Planted 1" deep into moisture and millet residue. Fall emergence was good, although minimal growth occurred. Timely rainfall received in spring and early summer. Moderate wheat stem sawfly pressure, although minimal lodging was noted in the trial at harvest.	N/A	N/A	N/A	N/A	Planted 2" deep into moisture and corn residue. Fall emergence was good, although minimal growth occurred. Timely rainfall received in spring. Light wheat stem sawfly pressure.	Planted 2" deep into moisture and tilled wheat residue. Fall emergence and growth was good. Trial was showing symptoms of drought stress by mid-spring.	N/A	Planted 1.5" deep into moisture and millet residue. Fall emergence and growth was good. Timely rainfall received in spring. Pythium was found in white heads (sporadic) in June. Moderate wheat stem sawfly pressure.	N/A	Planted 1.5" deep into moisture and tilled sorghum residue. Fall emergence and growth was very good. Good growth in the spring. Brown wheat mites noted in early spring along with drought stress symptoms. Timely rainfall received in May and early June.	Planted 1.5" deep into moisture and no-till wheat residue. Fall emergence and growth was very good. Lush growth in the spring. Cutworm damage noted in early spring, trial sprayed with insecticide on April 22.	N/A	Planted 1.5" deep into good moisture after corn harvest. Field had water applied immediately after planting. Good fall emergence and very late to green-up in the spring due to later planting date. Wheat stem sawfly present at low levels, but lodging was due to high yield.	Planted about 1.5" deep into moisture. Good fall emergence. Trial irrigated as needed starting in late spring.	Planted 1.5" deep into dry bean residue. Field had water applied immediately after planting. Good fall emergence and very late to green-up in the spring due to later planting date. Wheat stem sawfly was present at low levels, but lodging was due to high yield. Palisade plant growth regulator was applied in spring.

8 and 28 lb/ac of N and P were applied at planting as starter by Crops Testing.
Dashes denote missing information, N/A means not applicable

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Summary of 2024 Dryland Winter Wheat Variety Performance Results

Crops Testing
www.csucrops.com

Brand/Source	Market Class	Variety[a]	2024 Multi-Location Average Yield[b]	Yield	Test Weight	Protein[c]	Heading[d]	Sawfly Cutting[c]	2024 Individual Trial Yield[b] Akron	Julesburg	Lamar	Orchard	Sheridan Lake	Walsh
			bu/ac	percent of average	lb/bu	percent	days from average	rating (1-9)	bu/ac					
PlainsGold	HRW	Whistler	***59.5***	*109%*	*58.6*	*12.0*	*2*	*6*	95.5	68.5	48.5	54.5	**49.5**	41.5
PlainsGold	HRW	Avery	***58.7***	*107%*	*58.6*	*11.3*	*0*	*5*	97.0	63.5	45.0	59.0	38.5	**45.0**
PlainsGold	**HWW**	Monarch	***58.4***	*107%*	*59.7*	*11.7*	*1*	*4*	**99.5**	**74.0**	44.0	58.0	34.0	42.0
PlainsGold	HRW	Kivari AX	***58.3***	*107%*	*58.0*	*11.5*	*0*	*6*	90.5	62.0	**52.0**	61.5	40.5	41.5
AgriPro	HRW	AP Sunbird	***57.8***	*106%*	*60.3*	*11.7*	*-2*	*9*	**101.0**	**75.0**	43.0	62.0	34.0	31.5
PlainsGold	HRW	Byrd	***56.9***	*104%*	*59.4*	*11.9*	*-1*	*6*	93.5	67.0	43.0	60.5	35.5	41.0
CROPLAN	HRW	CP7017AX	*56.7*	*104%*	*59.5*	*12.1*	*-1*	*8*	89.5	67.5	47.5	55.0	40.5	**46.0**
PlainsGold	**HWW**	Breck	*56.6*	*103%*	*59.7*	*12.0*	*0*	*6*	90.0	65.5	46.0	59.5	39.5	38.5
PlainsGold	HRW	Canvas	*56.5*	*103%*	*59.4*	*12.2*	*1*	*4*	95.0	64.5	40.5	60.0	37.5	42.0
PlainsGold	HRW	Crescent AX	*56.2*	*103%*	*58.9*	*11.2*	*-1*	*7*	94.0	66.0	43.0	63.5	32.5	40.5
PlainsGold	HRW	Langin	*56.2*	*103%*	*58.8*	*11.6*	*-2*	*8*	98.0	70.0	40.0	60.0	33.5	34.0
PlainsGold	**HWW**	Snowmass 2.0	*55.7*	*102%*	*59.3*	*11.3*	*-2*	*5*	96.0	66.5	46.0	60.0	31.5	34.5
PlainsGold	HRW	Byrd CL Plus	*53.5*	*98%*	*58.8*	*11.6*	*-1*	*3*	89.0	64.0	36.5	60.0	34.0	37.0
PlainsGold	HRW	Amplify SF	*52.8*	*96%*	*59.5*	*12.2*	*2*	*1*	86.5	58.5	41.0	55.5	36.5	36.5
PlainsGold	**HWW**	Windom SF	*52.5*	*96%*	*56.2*	*12.3*	*1*	*2*	83.0	56.0	47.0	51.0	38.5	37.0
PlainsGold	HRW	Guardian	*51.6*	*94%*	*60.0*	*12.3*	*0*	*6*	86.0	59.0	41.0	54.0	36.0	38.5
PlainsGold	HRW	Fortify SF	*51.1*	*93%*	*59.1*	*12.3*	*0*	*2*	94.0	59.0	41.5	54.0	26.5	32.5
CROPLAN	HRW	CP7220	*48.0*	*88%*	*57.4*	*12.7*	*0*	*5*	77.5	63.0	40.0	52.0	27.0	29.5
Experimentals														
Colorado State University exp.	HRW	CO19D087R	***58.9***	*108%*	*58.4*	*11.3*	*-2*	*7*	**102.0**	66.5	43.0	61.0	37.5	42.0
Colorado State University exp.	HRW	CO19410R	***58.6***	*107%*	*60.1*	*12.0*	*0*	*6*	**102.0**	71.5	40.0	59.5	40.0	37.5
Colorado State University exp.	**HWW**	CO18D007W	***58.6***	*107%*	*59.5*	*11.6*	*-1*	*6*	94.0	69.0	47.0	58.0	45.0	39.5
Colorado State University exp.	HRW	CO19D304R	***57.8***	*106%*	*58.2*	*11.7*	*0*	*7*	93.5	69.0	48.5	52.0	42.0	42.0
Colorado State University exp.	HRW	CO18D297R	***57.8***	*106%*	*60.0*	*12.2*	*1*	*6*	96.0	64.5	45.0	54.5	43.5	**44.0**
Colorado State University exp.	HRW	CO18042RA	*55.7*	*102%*	*58.6*	*11.5*	*-2*	*5*	90.0	64.0	44.5	59.0	38.5	40.0
Colorado State University exp.	HRW	CO20SFD020R	*55.4*	*101%*	*60.3*	*11.3*	*1*	*2*	98.0	67.0	40.5	54.5	37.5	37.5
Colorado State University exp.	HRW	CO20D108R	*55.1*	*101%*	*59.8*	*11.2*	*0*	*3*	93.0	65.5	42.0	55.5	35.5	43.0
Colorado State University exp.	**HWW**	CO19S129W	*54.8*	*100%*	*59.7*	*12.2*	*1*	*4*	91.0	62.5	46.0	56.0	36.5	35.0
Colorado State University exp.	HRW	CO20022RC	*54.2*	*99%*	*59.2*	*11.8*	*2*	*7*	91.0	63.5	40.5	59.5	32.5	40.0
Colorado State University exp.	**HWW**	CO20SF014W	*53.7*	*98%*	*56.6*	*11.3*	*-1*	*1*	86.5	59.0	46.0	51.0	39.0	41.0
Colorado State University exp.	HRW	CO20SF141R	*52.7*	*96%*	*57.5*	*11.7*	*0*	*1*	81.0	59.0	47.0	54.0	37.0	38.0
Colorado State University exp.	HRW	CO19393R	*52.6*	*96%*	*59.8*	*11.9*	*1*	*5*	88.0	57.5	45.5	52.5	32.0	37.5
Colorado State University exp.	HRW	CO200037R	*51.9*	*95%*	*59.2*	*12.0*	*-1*	*2*	94.0	60.5	37.0	56.0	32.5	34.0
Colorado State University exp.	HRW	CO18035RA	*50.9*	*93%*	*59.3*	*11.6*	*0*	*5*	81.5	58.5	38.5	49.5	37.0	**43.5**
Colorado State University exp.	HRW	CO20SFD019R	*50.5*	*92%*	*60.3*	*12.4*	*-2*	*2*	92.5	66.0	36.0	53.0	26.0	31.5
Colorado State University exp.	HRW	CO21SF191RA	*48.6*	*89%*	*57.3*	*12.0*	*2*	*2*	75.0	56.5	40.0	49.0	42.0	32.5
Colorado State University exp.	HRW	CO21SF263RA	*45.7*	*83%*	*57.3*	*12.9*	*2*	*2*	70.0	49.0	37.5	40.5	39.5	35.5
		Average	***54.7***	***100%***	***59***	***11.8***	***0***	***4***	**91.0**	**64.0**	**43.0**	**56.0**	**36.5**	**38.5**
		[f]LSD (0.30)	2.6		0.6				3.6	2.7	2.8	2.9	3.3	2.6
		[f]LSD (0.05)	5.0		1.1				6.9	5.1	5.4	5.5	6.3	4.9

[a]Varieties grouped according to released varieties or experimentals, and then ranked from highest to lowest yield across six trials. Varieties not entered all dryland locations were not included to provide fair comparisons. Varieties entered in a single testing region (southeast or northeast Colorado) appear in the 2024 Colorado regional tables.

[b]Yield adjusted to 12% moisture content. Variety yield values in the top least significant difference (LSD) yield group across the locations and within each location are in bold. Multi-location yield values for each variety are least squares means and not arithmetic averages.

[c]Protein adjusted to 12% moisture content and averaged across six trials in 2024.

[d]Varieties with positive values headed later than the trial averages and varieties with negative values headed earlier than average. Based on three trials in 2023.

[e]Wheat Stem Sawfly cutting score: 1 equals no cutting and 9 is severe cutting. Scores are averaged across three replicates at Roggen (site not harvested for yield).

[f]Farmers selecting a variety based on yield should use the LSD (.30) to protect themselves from false negative conclusions (concluding varieties are the same when they are actually different). Companies or researchers may use the LSD (.05) to avoid false positive conclusions (concluding varieties are different when they are actually the same).

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Summary of 2024 Dryland Winter Wheat Variety Performance Results - Northeast Region

Crops Testing
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Brand/Source	Market Class	Variety[a]	2024 Multi-Location Average Yield[b]	Yield	Test Weight	Protein[c]	Heading[d]	2024 Individual Trial Yield[b] Akron	Julesburg	Orchard
			bu/ac	percent of average	lb/bu	percent	days from average	bu/ac		
AgriPro	HRW	AP Sunbird	*79.3*	*114%*	*58.6*	*10.6*	*-2*	**101.0**	**75.0**	62.0
PlainsGold	**HWW**	Monarch	*77.2*	*111%*	*58.2*	*11.1*	*1*	**99.5**	**74.0**	58.0
PlainsGold	HRW	Langin	*76.0*	*109%*	*57.5*	*10.4*	*-2*	98.0	70.0	60.0
PlainsGold	HRW	Crescent AX	*74.5*	*107%*	*57.6*	*11.0*	*-1*	94.0	66.0	63.5
PlainsGold	**HWW**	Snowmass 2.0	*74.2*	*107%*	*57.9*	*11.1*	*-2*	96.0	66.5	60.0
Crop Research Foundation of WY	HRW	Steamboat	*73.8*	*106%*	***60.2***	*10.7*	*0*	94.0	60.5	**67.0**
PlainsGold	HRW	Byrd	*73.7*	*106%*	*58.0*	*10.8*	*-1*	93.5	67.0	60.5
AgriPro	HRW	AP Bigfoot	*73.3*	*105%*	*59.0*	*11.4*	*-1*	94.0	65.5	60.5
PlainsGold	HRW	Avery	*73.2*	*105%*	*57.3*	*10.3*	*0*	97.0	63.5	59.0
PlainsGold	HRW	Canvas	*73.2*	*105%*	*57.2*	*11.1*	*1*	95.0	64.5	60.0
PlainsGold	HRW	Whistler	*72.8*	*105%*	*56.9*	*11.3*	*2*	95.5	68.5	54.5
PlainsGold	**HWW**	Breck	*71.7*	*103%*	*58.3*	*11.0*	*0*	90.0	65.5	59.5
PlainsGold	HRW	Kivari AX	*71.3*	*103%*	*55.8*	*10.9*	*0*	90.5	62.0	61.5
PlainsGold	HRW	Byrd CL Plus	*71.0*	*102%*	*57.5*	*10.9*	*-1*	89.0	64.0	60.0
CROPLAN	HRW	CP7017AX	*70.7*	*102%*	*57.6*	*12.0*	*-1*	89.5	67.5	55.0
PlainsGold	HRW	Fortify SF	*69.0*	*99%*	*57.9*	*11.5*	*0*	94.0	59.0	54.0
Frenchman Valley Coop	**HWW**	Valley	*68.2*	*98%*	*57.9*	*11.0*	*0*	90.0	63.5	51.0
Limagrain	HRW	LCS Radar	*67.8*	*98%*	*57.5*	*12.0*	*-1*	84.5	66.5	52.5
AgriPro	HRW	AP Solid	*67.3*	*97%*	*58.8*	*12.1*	*1*	79.5	63.5	59.0
PlainsGold	HRW	Amplify SF	*66.8*	*96%*	*57.9*	*11.1*	*2*	86.5	58.5	55.5
PlainsGold	HRW	Guardian	*66.3*	*95%*	*58.4*	*11.4*	*0*	86.0	59.0	54.0
NU Horizon Genetics	HRW	NHH19668	*66.3*	*95%*	***59.6***	*11.9*	*-1*	88.0	56.5	54.5
Kansas Wheat Alliance	HRW	KS Territory	*66.2*	*95%*	*56.2*	*11.9*	*1*	85.5	61.0	52.0
Limagrain	HRW	LCS Atomic AX	*65.3*	*94%*	*58.9*	*11.4*	*2*	88.0	55.5	52.5
Limagrain	**HWW**	LCS White Lightning	*64.5*	*93%*	*59.3*	*11.7*	*-1*	84.0	58.5	51.0
CROPLAN	HRW	CP7220	*64.2*	*92%*	*56.8*	*12.2*	*0*	77.5	63.0	52.0
PlainsGold	**HWW**	Windom SF	*63.3*	*91%*	*53.0*	*11.8*	*1*	83.0	56.0	51.0
Limagrain	HRW	LCS Steel AX	*57.2*	*82%*	*57.2*	*11.0*	*2*	69.0	54.0	48.5
Experimentals										
Colorado State University exp.	HRW	CO19410R	*77.7*	*112%*	*58.9*	*10.9*	*0*	**102.0**	71.5	59.5
Colorado State University exp.	HRW	CO19D087R	*76.5*	*110%*	*57.1*	*10.5*	*-2*	**102.0**	66.5	61.0
Colorado State University exp.	**HWW**	CO18D007W	*73.7*	*106%*	*58.1*	*10.8*	*-1*	94.0	69.0	58.0
Colorado State University exp.	HRW	CO20SFD020R	*73.2*	*105%*	*58.9*	*11.1*	*1*	98.0	67.0	54.5
Colorado State University exp.	HRW	CO18D297R	*71.7*	*103%*	*59.0*	*11.6*	*1*	96.0	64.5	54.5
Colorado State University exp.	HRW	CO19D304R	*71.5*	*103%*	*56.1*	*10.9*	*0*	93.5	69.0	52.0
Colorado State University exp.	HRW	CO20D108R	*71.3*	*103%*	*58.0*	*10.5*	*0*	93.0	65.5	55.5
Colorado State University exp.	HRW	CO20022RC	*71.3*	*103%*	*56.7*	*11.2*	*2*	91.0	63.5	59.5
Colorado State University exp.	HRW	CO18042RA	*71.0*	*102%*	*57.1*	*10.1*	*-2*	90.0	64.0	59.0
Colorado State University exp.	HRW	CO20SFD019R	*70.5*	*101%*	***60.2***	*11.4*	*-2*	92.5	66.0	53.0
Colorado State University exp.	HRW	CO200037R	*70.2*	*101%*	*56.9*	*11.6*	*-1*	94.0	60.5	56.0
Colorado State University exp.	**HWW**	CO19S129W	*69.8*	*100%*	*58.2*	*11.6*	*1*	91.0	62.5	56.0
Colorado State University exp.	HRW	CO19393R	*66.0*	*95%*	*58.3*	*11.1*	*1*	88.0	57.5	52.5
Colorado State University exp.	**HWW**	CO20SF014W	*65.5*	*94%*	*53.5*	*11.2*	*-1*	86.5	59.0	51.0
Colorado State University exp.	HRW	CO20SF141R	*64.7*	*93%*	*55.0*	*10.8*	*0*	81.0	59.0	54.0
Colorado State University exp.	HRW	CO18035RA	*63.2*	*91%*	*57.6*	*10.5*	*0*	81.5	58.5	49.5
Colorado State University exp.	HRW	CO21SF191RA	*60.2*	*87%*	*55.3*	*11.9*	*2*	75.0	56.5	49.0
Colorado State University exp.	HRW	CO21SF263RA	*53.2*	*76%*	*55.5*	*12.3*	*2*	70.0	49.0	40.5
		Average	***69.6***	***100%***	***57.6***	***11.2***	***0***	**90.0**	**63.0**	**55.5**
		[e]LSD (0.30)			0.7			3.6	2.7	2.9
		[e]LSD (0.05)			1.3			6.9	5.1	5.5
		Coeffecient of Variation (CV)			1.1			5.1	6.5	8.2

[a]Varieties grouped according to released varieties or experimentals, and then ranked from highest to lowest yield across three northeast Colorado region trials in 2024.

[b]Yield adjusted to 12% moisture content. Variety yield and test weight values in the top least significant difference (LSD) yield group are in bold. Multi-location test weight values for each variety are least squares means across the three sites and not arithmetic averages. Multi-location yield values for each variety are arithmetic averages from across the three sites and could not be statistically analyzed due to the wide variation among locations.

[c]Protein adjusted to 12% moisture content and averaged across three trials in 2024.

[d]Varieties with positive values headed later than the trial averages and varieties with negative values headed earlier than average. Based on three trials.

[e]Farmers selecting a variety based on yield should use the LSD (.30) to protect themselves from false negative conclusions (concluding varieties are the same when they are actually different). Companies or researchers may use the LSD (.05) to avoid false positive conclusions (concluding varieties are different when they are actually the

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Summary of 2024 Dryland Winter Wheat Variety Performance Results - Southeast Region

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Brand/Source	Market Class	Variety[a]	2024 Multi-Location Average Yield[b]	Yield	Test Weight[b]	Protein[c]	2024 Individual Trial Yield[b] Lamar	Sheridan Lake	Walsh
			bu/ac	percent of average	lb/bu	percent	bu/ac		
PlainsGold	HRW	Whistler	***45.7***	*118%*	*60.2*	*12.7*	48.5	**49.5**	41.5
PlainsGold	HRW	Kivari AX	***44.0***	*114%*	*60.3*	*12.2*	**52.0**	40.5	41.5
PlainsGold	**HWW**	Telluride	***43.5***	*112%*	*60.8*	*12.4*	47.0	45.0	39.5
PlainsGold	HRW	Avery	***43.1***	*111%*	*59.9*	*12.3*	45.0	38.5	**45.0**
CROPLAN	HRW	CP7017AX	*42.5*	*110%*	***61.5***	*12.1*	47.5	40.5	**46.0**
PlainsGold	HRW	Sheridan	*42.5*	*110%*	*60.7*	*12.9*	45.0	43.5	**44.0**
PlainsGold	**HWW**	Breck	*41.4*	*107%*	*61.1*	*13.0*	46.0	39.5	38.5
PlainsGold	HRW	Byrd	*40.3*	*104%*	*60.8*	*13.0*	43.0	35.5	41.0
PlainsGold	**HWW**	Windom SF	*39.8*	*103%*	*59.4*	*12.8*	47.0	38.5	37.0
PlainsGold	HRW	Canvas	*39.3*	*102%*	***61.5***	*13.2*	40.5	37.5	42.0
PlainsGold	**HWW**	Monarch	*39.2*	*101%*	***61.3***	*12.2*	44.0	34.0	42.0
PlainsGold	HRW	Crescent AX	*38.3*	*99%*	*60.2*	*11.7*	43.0	32.5	40.5
PlainsGold	HRW	Guardian	*37.8*	*98%*	***61.6***	*13.1*	41.0	36.0	38.5
PlainsGold	HRW	Amplify SF	*37.6*	*97%*	*61.1*	*13.4*	41.0	36.5	36.5
PlainsGold	**HWW**	Snowmass 2.0	*36.8*	*95%*	*60.7*	*11.7*	46.0	31.5	34.5
PlainsGold	HRW	Byrd CL Plus	*36.0*	*93%*	*60.2*	*12.3*	36.5	34.0	37.0
PlainsGold	HRW	Langin	*35.1*	*91%*	*60.1*	*12.8*	40.0	33.5	34.0
AgriPro	HRW	AP Sunbird	*34.6*	*89%*	***61.9***	*12.9*	43.0	34.0	31.5
PlainsGold	HRW	Fortify SF	*34.3*	*89%*	*60.2*	*13.0*	41.5	26.5	32.5
Limagrain	HRW	LCS Julep	*33.8*	*87%*	***61.5***	*13.6*	34.0	34.0	36.0
CROPLAN	HRW	CP7220	*31.0*	*80%*	*58.0*	*13.2*	40.0	27.0	29.5
Experimentals									
Colorado State University exp.	HRW	CO19D304R	***44.4***	*115%*	*60.4*	*12.4*	48.5	42.0	42.0
Colorado State University exp.	**HWW**	CO20SF014W	*41.4*	*107%*	*59.8*	*11.4*	46.0	39.0	41.0
Colorado State University exp.	HRW	CO19D087R	*41.3*	*107%*	*59.7*	*12.0*	43.0	37.5	42.0
Colorado State University exp.	HRW	CO18042RA	*41.3*	*107%*	*60.2*	*12.9*	44.5	38.5	40.0
Colorado State University exp.	HRW	CO20SF141R	*39.6*	*102%*	*60.0*	*12.6*	47.0	37.0	38.0
Colorado State University exp.	HRW	CO18035RA	*39.5*	*102%*	*61.0*	*12.7*	38.5	37.0	**43.5**
Colorado State University exp.	HRW	CO19410R	*38.7*	*100%*	***61.3***	*13.0*	40.0	40.0	37.5
Colorado State University exp.	HRW	CO20D108R	*38.2*	*99%*	***61.5***	*11.8*	42.0	35.5	43.0
Colorado State University exp.	HRW	CO20SFD020R	*38.1*	*98%*	***61.5***	*11.6*	40.5	37.5	37.5
Colorado State University exp.	HRW	CO20022RC	*37.7*	*98%*	***61.7***	*12.3*	40.5	32.5	40.0
Colorado State University exp.	HRW	CO21SF191RA	*37.7*	*98%*	*59.3*	*12.1*	40.0	42.0	32.5
Colorado State University exp.	HRW	CO19393R	*37.5*	*97%*	***61.2***	*12.6*	45.5	32.0	37.5
Colorado State University exp.	HRW	CO21SF263RA	*37.5*	*97%*	*59.2*	*13.5*	37.5	39.5	35.5
Colorado State University exp.	**HWW**	CO19S129W	*37.1*	*96%*	*61.1*	*12.7*	46.0	36.5	35.0
Colorado State University exp.	HRW	CO200037R	*34.3*	*89%*	***61.5***	*12.3*	37.0	32.5	34.0
Colorado State University exp.	HRW	CO20SFD019R	*30.4*	*79%*	*60.4*	*13.4*	36.0	26.0	31.5
		Average	***38.7***	***100%***	***60.6***	***12.6***	**43.0**	**36.5**	**38.5**
		[d]LSD (0.30)	2.7		0.7		2.8	3.3	2.6
		[d]LSD (0.05)	5.1		1.2		5.4	6.3	4.9
		Coeffecient of Variation (CV)	7.1		1.7		5.4	7.2	13.0

[a]Varieties grouped according to released varieties or experimentals, and then ranked from highest to lowest yield across three southeast Colorado trials in 2024.

[b]Yield adjusted to 12% moisture content. Variety yield and test weight values in the top least significant difference (LSD) yield group are in bold. Multi-location yield and test weight values for each variety are least squares means across the three sites and not arithmetic averages.

[c]Protein adjusted to 12% moisture content and averaged across three trials in 2024.

[d]Farmers selecting a variety based on yield should use the LSD (.30) to protect themselves from false negative conclusions (concluding varieties are the same when they are actually different). Companies or researchers may use the LSD (.05) to avoid false positive conclusions (concluding varieties are different when they are actually the same).

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Summary of 2-Year (2023-2024) Dryland Winter Wheat Variety Performance Results

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Brand/Source	Market Class[b]	Variety[c]	2-Year Average[a] Yield	Yield	Test Weight	Test Weight	Plant Height	Protein
			bu/ac	% trial average	lb/bu	% trial average	in	percent
PlainsGold	**HWW**	Monarch	69.9	108%	58.3	101%	28	11.0
Colorado State University exp.	HRW	CO19410R	69.3	107%	58.6	101%	29	11.4
Colorado State University exp.	**HWW**	CO18D007W	67.5	104%	58.1	101%	29	10.9
Colorado State University exp.	HRW	CO19D087R	67.5	104%	56.8	98%	27	11.1
Colorado State University exp.	HRW	CO19D304R	67.2	104%	56.6	98%	31	11.1
CROPLAN	HRW	CP7017AX	67.1	104%	58.7	102%	28	11.3
Colorado State University exp.	HRW	CO18D297R	66.8	103%	58.8	102%	30	11.6
PlainsGold	HRW	Whistler	66.8	103%	56.8	98%	31	11.0
PlainsGold	**HWW**	Snowmass 2.0	66.4	102%	57.8	100%	28	11.0
Colorado State University exp.	HRW	CO20D108R	66.1	102%	58.0	101%	29	10.9
PlainsGold	HRW	Avery	65.6	101%	57.1	99%	30	10.6
Colorado State University exp.	HRW	CO19393R	65.5	101%	57.9	100%	30	11.3
Colorado State University exp.	**HWW**	CO19S129W	65.1	101%	58.1	101%	29	11.3
PlainsGold	HRW	Crescent AX	64.9	100%	58.3	101%	30	11.1
PlainsGold	HRW	Kivari AX	64.6	100%	56.3	97%	29	10.8
PlainsGold	HRW	Byrd	64.5	100%	58.1	101%	30	11.0
PlainsGold	HRW	Canvas	63.8	99%	57.7	100%	29	11.6
Colorado State University exp.	HRW	CO18042RA	63.7	98%	57.5	100%	30	10.9
PlainsGold	**HWW**	Breck	63.4	98%	58.7	102%	29	11.3
PlainsGold	HRW	Amplify SF	62.9	97%	57.9	100%	30	11.7
PlainsGold	HRW	Byrd CL Plus	62.7	97%	57.4	99%	31	11.0
PlainsGold	HRW	Langin	62.5	97%	57.1	99%	28	11.2
Colorado State University exp.	HRW	CO18035RA	62.2	96%	57.6	100%	28	11.3
Colorado State University exp.	HRW	CO200037R	61.7	95%	57.7	100%	28	11.4
PlainsGold	HRW	Guardian	61.7	95%	58.8	102%	28	11.6
PlainsGold	**HWW**	Windom SF	60.0	93%	56.4	98%	27	11.4
PlainsGold	HRW	Fortify SF	59.0	91%	57.6	100%	30	11.3
		Average	**64.7**	**100%**	**58**	**100%**	**29**	**11.2**

[a]The 2-year average yield and test weight are based on 13 trials (six 2024 and ten 2023 trials). Plant heights and protein are based on 13 trials (six 2024 and seven 2023 trials).

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

[c]Varieties ranked from highest to lowest average 2-year yield.

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Summary of 3-Year (2022-2024) Dryland Winter Wheat Variety Performance Results

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Brand/Source	Market Class[b]	Variety[c]	3-Year Average[a] Yield	Yield	Test Weight	Test Weight	Plant Height	Protein
			bu/ac	% trial average	lb/bu	% trial average	in	percent
PlainsGold	**HWW**	Monarch	64.4	109%	58.4	101%	27	11.5
Colorado State University exp.	**HWW**	CO18D007W	62.1	105%	58.3	101%	28	11.5
PlainsGold	HRW	Whistler	61.6	104%	57.1	98%	29	11.5
Colorado State University exp.	HRW	CO18D297R	61.5	104%	58.9	102%	28	12.1
CROPLAN	HRW	CP7017AX	61.4	104%	58.9	102%	26	11.7
PlainsGold	HRW	Avery	60.8	103%	57.4	99%	28	11.1
PlainsGold	**HWW**	Snowmass 2.0	60.3	102%	58.0	100%	26	11.4
PlainsGold	HRW	Crescent AX	60.0	101%	58.4	101%	28	11.7
PlainsGold	HRW	Kivari AX	60.0	101%	56.7	98%	27	11.3
PlainsGold	HRW	Byrd	59.7	101%	58.3	100%	28	11.4
PlainsGold	HRW	Canvas	59.0	100%	58.1	100%	27	12.0
Colorado State University exp.	HRW	CO18042RA	58.9	99%	57.7	100%	28	11.4
PlainsGold	**HWW**	Breck	58.5	99%	59.0	102%	27	11.8
PlainsGold	HRW	Amplify SF	58.1	98%	58.2	100%	28	12.1
Colorado State University exp.	HRW	CO18035RA	57.9	98%	57.8	100%	27	11.6
PlainsGold	HRW	Byrd CL Plus	57.8	97%	57.5	99%	29	11.5
PlainsGold	HRW	Langin	57.7	97%	57.4	99%	26	11.7
PlainsGold	HRW	Guardian	57.0	96%	58.9	102%	27	12.0
PlainsGold	**HWW**	Windom SF	55.1	93%	56.6	98%	26	12.0
PlainsGold	HRW	Fortify SF	54.2	91%	57.9	100%	28	11.8
		Average	**59.3**	**100%**	**58**	**100%**	**27**	**11.7**

[a]The 3-year average yield and test weight are based on 19 trials (six 2024, ten 2023, and three 2022). Plant heights and protein are based on 16 trials (six 2024, seven 2023, and three 2022).

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

[c]Varieties ranked from highest to lowest average 3-year yield.

Contact Sally Jones-Diamond (sally.jones@colostate.edu)

2024 Collaborative On-Farm Test (COFT) Variety Peformance Results

Sally Jones-Diamond, Jason Webb, Ron Meyer, Michaela Mattes, Kat Caswell, and Catie Green

The COFT program is in its 28th year and the majority of Colorado's winter wheat acreage is planted to varieties that have been tested in the program. On-farm testing leads to more rapid replacement of old inferior varieties and wider and faster adoption of improved varieties. It also brings Colorado State University wheat results to rural communities. The varieties tested in COFT this year fit different farmer needs and producers are encouraged to study the tables in the Description of Winter Wheat Varieties in Eastern Colorado and the Dryland Decision Tree for more information.

In the fall of 2023, twenty-five eastern Colorado wheat producers received seed of five varieties of wheat and planted them in side-by-side strips under the same conditions as the wheat in the rest of the field. Eighteen viable harvest results were obtained. The objective of our on-farm testing program is to compare the performance of wheat varieties of interest for Colorado farmers under their field conditions. Each of the five varieties tested has potential advantages for farmers and should be chosen on a case-by-case basis depending on the specific farm needs. There was a sixth 'treatment' this year, which was a biological seed treatment from Indigo Ag. applied to Amplify SF. For an accurate comparison of the seed treatment, Amplify SF was included twice in the strips, once as regular variety treated only with the regular fungicide seed treatment (e.g. Cruiser Maxx Cereals) and again with the regular fungicide seed treatment and the Indigo Ag. bacterial biological treatment added.

The same six varieties/treatments were included in all tests. Amplify SF (regular and treated with Indigo seed treatment), AP Solid, Guardian, Kivari AX, and KS Territory are all hard red winter wheat varieties. Two semi-solid stemmed varieties were included in the test to help combat the wheat stem sawfly (WSS): Amplify SF and AP Solid. One CoAXium® variety was also included for grass weed control, Kivari AX. Two regular hard red varieties were included for their excellent Wheat streak mosaic virus resistance Guardian and KS Territory.

Amplify SF is a CSU release (2021), marketed by PlainsGold. Amplify SF has a semi-solid stem, is medium maturity, and has good standability under severe WSS pressure with an average yield. The Indigo Ag. seed treatment used was W13, which is a dry powder containing beneficial, naturally occurring microbes to help improve plant growth and productivity throughout the season. The product was applied to dry seed at the labeled application rate of 1 volume ounce per 100 pounds of seed.

AP Solid is an AgriPro release (2021). AP Solid is a medium-late semi-solid stem variety that stands up well to heavy WSS pressure. It has very good test weight and straw strength.
Kivari AX is a CSU release (2020) marketed by PlainsGold. Higher yielding and slightly later maturing than Crescent AX, it shows intermediate reaction to stripe rust and carries wheat curl mite resistance. The CoAXium® Wheat Production System is based on the Aggressor® herbicide, a different class of compounds from Beyond®, and provides excellent control of winter annual grasses.

Guardian is a CSU release (2019), marketed by PlainsGold. It is medium maturing, has average straw strength, and has good stripe and stem rust resistance. It has excellent wheat curl mite resistance from the Byrd parent and excellent resistance to WSMV. It is below-average yield in the three-year trial average but has very good test weight.

KS Territory is a Kansas State University release (2022), marketed by the Kansas Wheat Alliance. It is medium maturing, has very good straw strength, and resistance to WSMV and Triticum mosaic virus, and excellent stripe rust tolerance.

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Summary of 2024 Collaborative On-Farm Test (COFT) Winter Wheat Variety Results (18 tests included)

Variety	Yield[a]	Test Weight	Protein[a]
	bu/ac	lb/bu	percent
Kivari AX	**48.8**	59.9	11.4
Amplify SF + Indigo Seed Trt.	**47.6**	61.1	12.0
Amplify SF	46.5	61.1	12.0
AP Solid	46.5	61.6	12.1
Guardian	45.5	60.6	12.4
KS Territory	44.2	58.9	12.4
Average	**46.5**	**60.5**	**12.1**
$LSD_{(0.30)}$	1.5	0.5	0.2
Coefficient of Variation (CV)	9.3%	2.4%	4.5%

[a]Yield and protein corrected to 12% moisture.

COLORADO STATE UNIVERSITY EXTENSION

Summary of 2024 Collaborative On-Farm Test (COFT) Winter Wheat Variety Performance Results

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2024 Varieties (ranked left to right by highest yield)

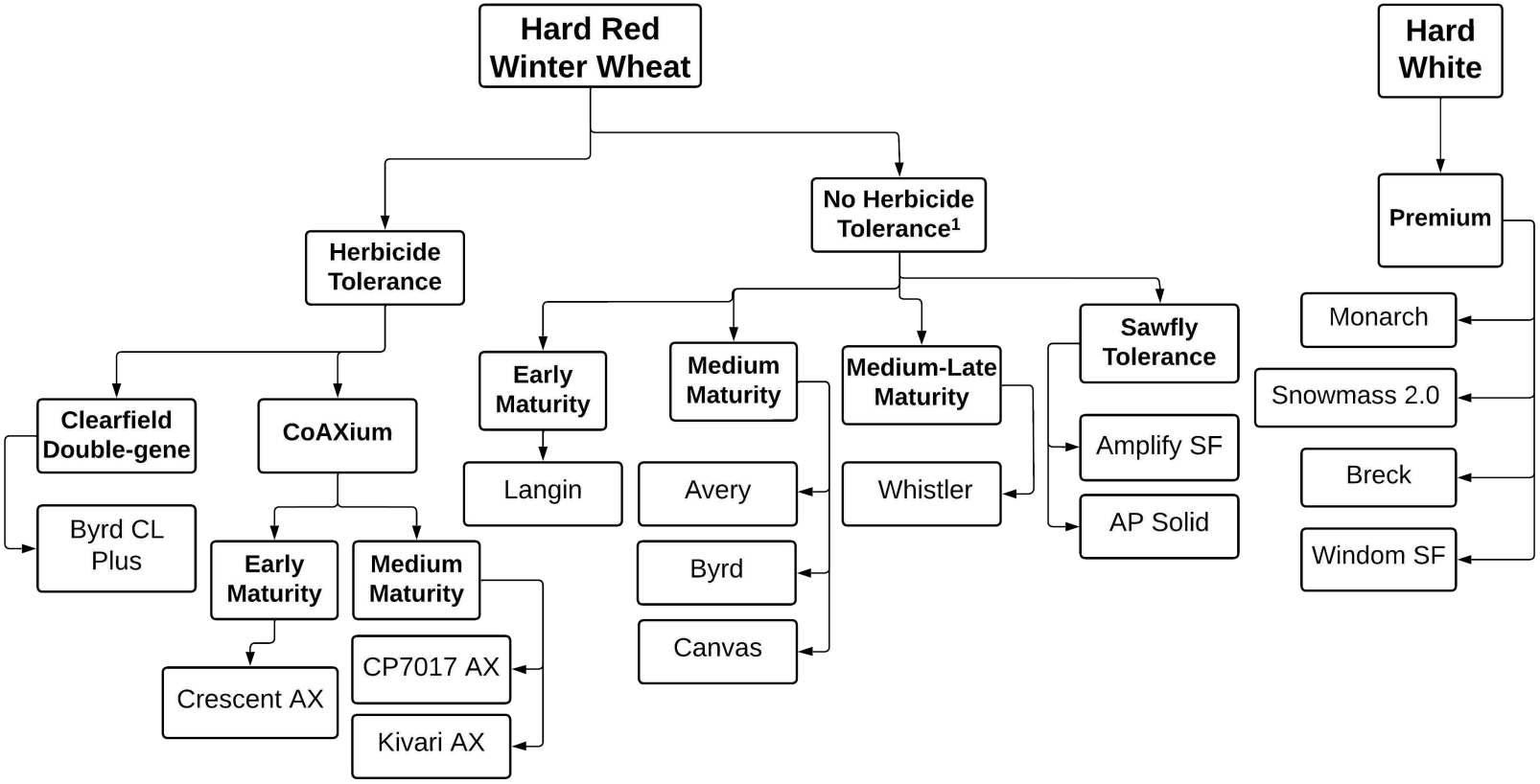
Nearest Town/County	Kivari AX			Amplify SF with Indigo Seed Treatment			Amplify SF			AP Solid			Guardian			KS Territory			COFT Average		
	Yield[a]	Test Weight	Protein	Yield[a]	Test Weight	Protein	Yield[a]	Test Weight	Protein	Yield[a]	Test Weight	Protein	Yield[a]	Test Weight	Protein	Yield[a]	Test Weight	Protein	Yield[a]	Test Weight	Protein
	bu/ac	lb/bu	percent	bu/ac	lb/bu	percent	bu/ac	lb/bu	percent	bu/ac	lb/bu	percent	bu/ac	lb/bu	percent	bu/ac	lb/bu	percent	bu/ac	lb/bu	percent
Anton/Washington	53	58	14	53	59	14	53	59	15	52	60	14	48	58	16	46	56	16	**51**	**58**	**15**
Arriba/Lincoln	54	61	11	68	60	11	56	60	11	57	57	11	66	62	11	45	58	11	**58**	**60**	**11**
Bennett/Adams	72	59	11	66	60	12	65	61	11	64	61	11	62	60	12	62	58	12	**65**	**60**	**11**
Bethune/Kit Carson	47	61	14	43	62	15	41	63	15	43	63	15	37	63	15	41	55	15	**42**	**61**	**15**
Burlington/Kit Carson	49	63	12	32	62	13	36	63	13	34	63	13	40	62	13	39	61	13	**38**	**62**	**13**
Byers/Adams	59	63	12	52	64	13	58	64	13	58	64	13	58	64	13	63	63	13	**58**	**64**	**13**
Cheyenne Wells/Cheyenne	57	61	11	59	61	12	54	61	12	52	63	13	55	60	13	55	62	12	**55**	**61**	**12**
Eads/Kiowa	20	60	9	23	63	9	21	63	9	25	64	9	24	63	9	21	62	10	**22**	**62**	**9**
Julesburg/Sedgwick	42	60	11	39	62	12	39	61	12	37	63	12	37	63	12	43	60	12	**40**	**61**	**12**
Lamar S/Prowers	46	61	10	41	63	11	43	62	12	42	63	13	42	62	12	36	63	11	**42**	**62**	**11**
Lamar SW/Bent	27	58	11	30	58	12	27	58	12	30	60	12	29	60	12	33	57	12	**29**	**58**	**12**
Leroy/Logan	49	55	12	54	59	13	49	60	12	53	60	13	43	59	13	47	56	14	**49**	**58**	**13**
Otis/Washington	41	56	13	51	60	13	49	59	14	48	60	14	39	57	15	45	51	15	**46**	**57**	**14**
Prospect Valley/Adams	33	61	11	34	62	11	36	62	12	35	60	11	29	57	11	24	62	11	**32**	**61**	**11**
Severance/Weld (Irrigated)	137	64	13	122	61	12	126	62	12	118	62	11	135	61	12	116	59	13	**126**	**61**	**12**
Vilas/Baca	20	58	9	15	58	11	17	59	10	20	59	9	11	58	12	14	58	10	**16**	**58**	**10**
Walsh/Baca	43	62	-	41	63	-	37	63	-	38	64	-	39	64	-	38	62	-	**39**	**63**	**-**
Yuma/Yuma	29	58	12	32	63	11	30	62	11	31	63	12	25	60	12	28	59	12	**29**	**61**	**12**
Average	**48.8**	**59.9**	**11.4**	**47.6**	**61.1**	**12.0**	**46.5**	**61.1**	**12.0**	**46.5**	**61.6**	**12.1**	**45.5**	**60.6**	**12.4**	**44.2**	**58.9**	**12.4**	**46.5**	**60.5**	**12.1**
Yield Significance[b]	A			A,B			B,C			B,C			C,D			D					

LSD $_{(P<0.30)}$ for yield = 1.5 bu/ac, for test weight = 0.5 lb/bu, and for protein = 0.2 percent

[a]All yield and protein data are corrected to 12% moisture.

[b]Yield significance: varieties with different letters have yields that are significantly different from one another.

CSU Fall 2024 Dryland Winter Wheat Decision Tree



[1]No tolerance to herbicides used in Clearfield or CoAXium wheat production systems.
In categories with two or more varieties, they are listed from highest to lowest yield based on the 3-year CSU trial averages.

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Summary of 2024 Irrigated Winter Wheat Variety Performance Results

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Brand/Source	Market Class	Variety[a]	2024 Multi-Location Average Yield[b]	Yield	Test Weight	Protein[c]	Lodging	Heading[d]	2024 Individual Trial Yield[b] Burlington	Fort Collins	Wiggins
			bu/ac	percent of average	lb/bu	percent	score (1-9)[e]	days from average	bu/ac		
Colorado State University exp.	HRW	CO19D304R	***129.0***	*109%*	*60.1*	*12.5*	*1*	*3*	**100.5**	**126.0**	163.0
Colorado State University exp.	HRW	CO20022RC	*123.3*	*104%*	***61.5***	*12.8*	*1*	*0*	94.0	122.0	156.0
PlainsGold	HRW	Crescent AX	*123.3*	*104%*	*59.9*	*13.0*	*7*	*-2*	**100.5**	115.5	153.0
PlainsGold	**HWW**	Monarch	*123.2*	*104%*	*60.1*	*12.6*	*1*	*0*	94.5	121.0	152.0
Colorado State University exp.	HRW	CO20SFD020R	*122.9*	*104%*	***61.3***	*12.4*	*1*	*2*	94.0	111.5	**167.5**
Colorado State University exp.	**HWW**	CO18D007W	*122.3*	*103%*	*59.9*	*12.6*	*1*	*-1*	86.0	**127.0**	150.5
Colorado State University exp.	HRW	CO18D297R	*121.9*	*103%*	***60.7***	*12.7*	*1*	*0*	88.0	**123.5**	155.0
CROPLAN	HRW	CP7017AX	*121.6*	*103%*	*60.6*	*12.9*	*2*	*-1*	94.0	122.5	145.5
PlainsGold	HRW	Canvas	*121.4*	*102%*	***60.9***	*13.0*	*1*	*0*	95.5	122.5	148.5
AgriPro	HRW	SY Wolverine	*121.2*	*102%*	*58.6*	*13.6*	*1*	*2*	92.0	**125.0**	151.0
PlainsGold	**HWW**	Windom SF	*120.1*	*101%*	*59.0*	*12.9*	*2*	*-2*	91.5	115.5	153.5
PlainsGold	**HWW**	Breck	*120.0*	*101%*	***61.0***	*13.7*	*3*	*0*	90.0	115.5	155.0
PlainsGold	HRW	Kivari AX	*119.5*	*101%*	*58.5*	*12.2*	*7*	*0*	95.5	119.0	144.5
PlainsGold	HRW	Byrd CL Plus	*118.4*	*100%*	*60.1*	*13.2*	*3*	*0*	84.5	110.5	161.5
PlainsGold	HRW	Amplify SF	*118.2*	*100%*	*60.3*	*13.1*	*1*	*1*	86.5	108.5	158.5
PlainsGold	HRW	Guardian	*116.2*	*98%*	*60.2*	*13.5*	*1*	*1*	87.0	113.0	147.5
PlainsGold	**HWW**	Snowmass 2.0	*116.2*	*98%*	*59.8*	*12.9*	*1*	*-3*	92.0	114.0	143.0
Limagrain	HRW	LCS Radar	*114.6*	*97%*	*59.7*	*13.8*	*1*	*-4*	86.5	116.5	141.5
Limagrain	HRW	LCS Steel AX	*114.1*	*96%*	*58.9*	*13.2*	*1*	*4*	80.0	122.0	139.0
Colorado State University exp.	HRW	CO21SF191RA	*113.2*	*96%*	*58.1*	*14.1*	*2*	*3*	75.5	109.0	153.0
Limagrain	HRW	LCS Atomic AX	*113.0*	*95%*	*60.3*	*13.0*	*2*	*0*	86.0	106.5	145.0
NU Horizon Genetics	HRW	NE Prism CL2	*112.8*	*95%*	*60.2*	*13.7*	*1*	*0*	77.0	114.5	146.5
Colorado State University exp.	HRW	CO20SFD019R	*111.0*	*94%*	***60.9***	*13.3*	*1*	*-4*	85.5	106.0	145.0
CROPLAN	HRW	CP7266AX	*106.1*	*90%*	*60.2*	*12.6*	*2*	*0*	73.5	109.0	137.5
		Average	***118.5***	***100%***	***60***	***13.1***	***2***	***0***	**89.0**	**116.5**	**150.5**
		[f]LSD (0.30)	5.1		0.8				3.4	4.4	2.9
		[f]LSD (0.05)	9.7		1.6				6.6	8.4	5.6

[a]Varieties ranked from highest to lowest yield across three irrigated trials in 2024.

[b]Yield adjusted to 12% moisture content. Variety yield values in the top least significant difference (LSD) yield group across the locations and within each location are in bold. Multi-location yield values for each variety are least squares means and not arithmetic averages.

[c]Protein adjusted to 12% moisture content and averaged across two trials in 2024.

[d]Varieties with positive values headed later than the trial averages and varieties with negative values headed earlier than average. Based on one trial.

[e]Lodging score: 1 equals no lodging and 9 is severe lodging. Scores from three trials in 2024.

[f]Farmers selecting a variety based on yield should use the LSD (.30) to protect themselves from false negative conclusions (concluding varieties are the same when they are actually different). Companies or researchers may use the LSD (.05) to avoid false positive conclusions (concluding varieties are different when they are actually the same).

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Summary of 2-Year (2023-2024) Irrigated Winter Wheat Variety Performance Results

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Brand/Source	Market Class[b]	Variety[c]	2-Year Average[a] Yield	Yield	Test Weight	Test Weight	Plant Height	Protein
			bu/ac	% trial average	lb/bu	% trial average	in	percent
Colorado State University exp.	HRW	CO19D304R	114.8	106%	58.8	100%	33	12.2
Colorado State University exp.	HRW	CO18D297R	114.6	105%	59.8	102%	31	12.5
PlainsGold	**HWW**	Monarch	114.3	105%	59.2	101%	30	12.0
PlainsGold	HRW	Crescent AX	111.2	102%	59.4	101%	31	12.6
CROPLAN	HRW	CP7017AX	110.8	102%	59.5	101%	30	12.4
PlainsGold	HRW	Amplify SF	110.8	102%	59.1	101%	33	12.8
Colorado State University exp.	**HWW**	CO18D007W	110.3	101%	58.2	99%	31	12.3
PlainsGold	HRW	Byrd CL Plus	110.1	101%	58.5	100%	33	12.5
PlainsGold	HRW	Canvas	110.0	101%	59.1	101%	30	12.7
AgriPro	HRW	SY Wolverine	109.3	101%	57.3	98%	30	13.1
PlainsGold	HRW	Guardian	108.9	100%	59.4	101%	32	13.1
PlainsGold	**HWW**	Snowmass 2.0	106.7	98%	58.1	99%	29	12.6
PlainsGold	**HWW**	Windom SF	106.3	98%	57.6	98%	29	12.6
PlainsGold	**HWW**	Breck	106.0	98%	59.2	101%	31	13.0
Limagrain	HRW	LCS Steel AX	105.6	97%	58.7	100%	32	12.9
PlainsGold	HRW	Kivari AX	103.7	95%	57.1	97%	31	11.7
Limagrain	HRW	LCS Atomic AX	102.8	95%	59.3	101%	31	12.6
CROPLAN	HRW	CP7266AX	100.3	92%	59.1	101%	30	12.4
		Average	**108.7**	**100%**	**58.8**	**100%**	**31**	**12.6**

[a]The 2-year average yield, test weight, and protein are based on six trials (three 2024 and three 2023). Plant heights are based on five trials (three 2024 and two 2023).

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

[c]Varieties ranked from highest to lowest average 2-year yield.

COLORADO STATE UNIVERSITY EXTENSION

Summary of 3-Year (2022-2024) Irrigated Winter Wheat Variety Performance Results

Crops Testing www.csucrops.com

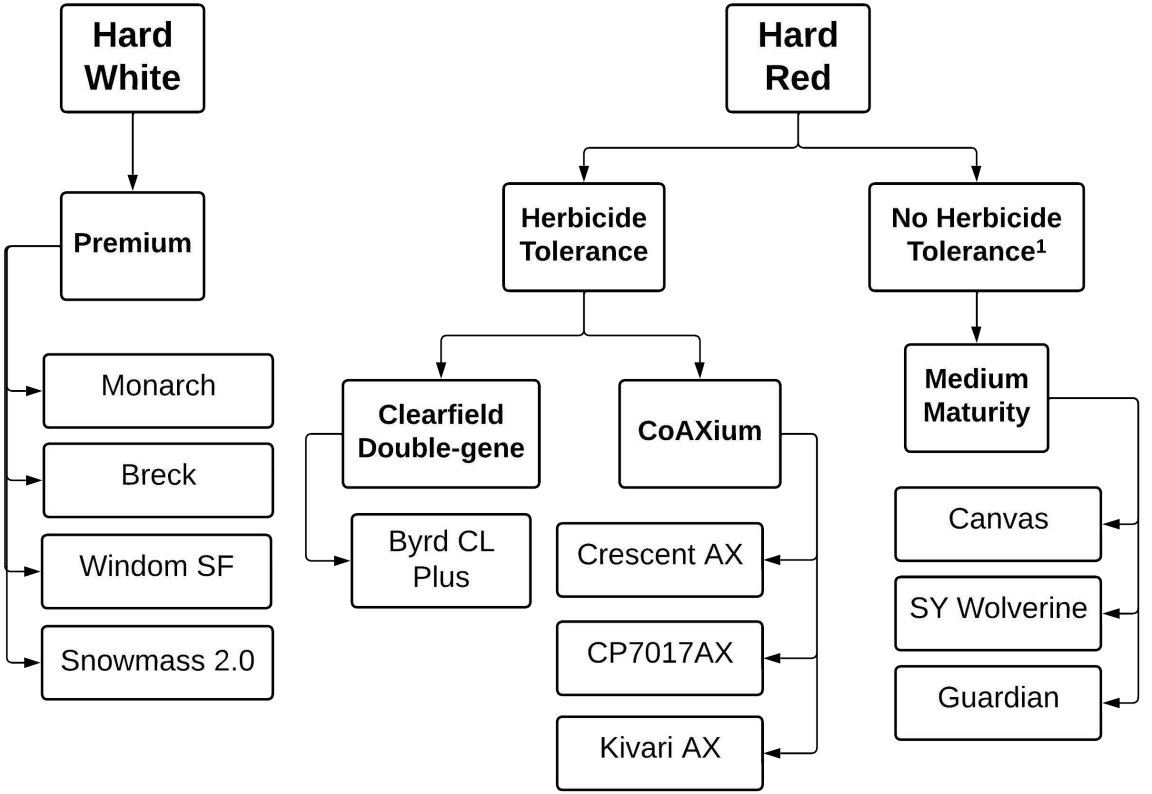
Brand/Source	Market Class[b]	Variety[c]	3-Year Average[a] Yield	Yield	Test Weight	Test Weight	Plant Height	Protein
			bu/ac	% trial average	lb/bu	% trial average	in	percent
Colorado State University exp.	HRW	CO18D297R	105.1	106%	60.1	101%	29	13.0
PlainsGold	**HWW**	Monarch	103.2	104%	59.6	100%	29	12.5
Colorado State University exp.	**HWW**	CO18D007W	102.3	104%	59.3	100%	29	13.0
PlainsGold	HRW	Crescent AX	101.0	102%	60.0	101%	30	13.2
CROPLAN	HRW	CP7017AX	100.9	102%	60.2	101%	28	13.1
PlainsGold	HRW	Canvas	100.5	102%	59.7	100%	29	13.3
PlainsGold	HRW	Byrd CL Plus	99.2	100%	59.2	99%	32	13.2
PlainsGold	**HWW**	Breck	97.7	99%	60.1	101%	29	13.7
PlainsGold	**HWW**	Windom SF	97.7	99%	58.7	99%	27	13.2
PlainsGold	HRW	Guardian	97.5	99%	60.0	101%	31	13.8
PlainsGold	HRW	Kivari AX	95.9	97%	58.3	98%	30	12.3
PlainsGold	**HWW**	Snowmass 2.0	93.5	95%	58.9	99%	29	13.4
CROPLAN	HRW	CP7266AX	90.9	92%	59.6	100%	29	13.2
		Average	**98.9**	**100%**	**59.5**	**100%**	**29**	**13.1**

[a]The 3-year average yield, test weight, and protein are based on nine trials (three each year). Plant heights are based on seven trials (three 2024, two 2023 and three 2022).

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

[c]Varieties ranked from highest to lowest average 2-year yield.

CSU Fall 2024 Irrigated Winter Wheat Decision Tree



[1]No tolerance to herbicides used in Clearfield or CoAXium wheat production systems.
In categories with two or more varieties, they are listed from highest to lowest yield based on the 2 or 3-year CSU trial averages.

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Wheat Production Management Tips

Sally Jones-Diamond and Tyler Benninghoven

These tips are designed to help farmers make better management decisions for their fields and farm as a whole. Although wheat is a commonly grown crop in our region, sometimes basic agronomic practices that can vastly improve the production of the crop are ignored or forgotten. These are also tips that can help prevent problems during the growing season when it's often too late to fix, such as with wheat viral diseases.

- **Focus on multi-year and location yield summary results when selecting a variety**. Use results from the two or three-year variety performance trials. Results across years and locations are a better predictor of how a variety will perform on your farm than looking at single year or location data. All CSU replicated wheat variety trial results can be accessed at our Crops Testing Program website at www.csucrops.org. You can also use the wheat variety database, which is an excellent resource for regional and multi-state data found at www.wheattrials.com.

- **Plant multiple varieties with different maturity and agronomic qualities to spread and reduce the risk of crop damage from environmental issues (drought, pests, etc.).** Planting a single variety across your whole farm can pose undue risk to your production as no single variety is best suited for all of your acres. Focus on a few important characteristics and find varieties that are best suited to each of them (examples could be high yielding, sawfly tolerance, virus resistance, early maturity, etc).

- **Plant in seeds per acre and not in pounds per acre.** Different varieties and seed lots can vary widely in seed size. Reassess and adjust your seeding rate as necessary when changing varieties, switching seed lots, and as planting season progresses. Plant population is very impactful to success with all crop production, and it's a factor we can control so we should aim to be accurate.

- **Control volunteer wheat and weeds to avoid loss of valuable soil moisture and to avoid creating a green bridge.** A green bridge is an area where the presence of weeds or volunteer wheat allows for unimpeded disease spread. Green bridges can lead to serious virus disease infections vectored by the wheat curl mite (wheat streak mosaic virus, High Plains wheat mosaic virus, and Triticum mosaic virus) or vectored by aphids (barley yellow dwarf virus and cereal yellow dwarf virus).

- **Plant nutrition is vital to produce healthy, high yielding, protein-rich grain.** Whether using conventional or organic sources, always aim to understand plant nutrition better each season. Never stop experimenting - incremental changes in plant available macronutrients like nitrogen, phosphorous, potassium, and sulfur are a great place to start. Nothing proves the success of a practice better than seeing the difference on your own farm.

- **Soil sample periodically to determine optimum fertilizer application rates.** Sampling should be done prior to planting. Soil samples can be sent to the CSU Soil, Water, and Plant Testing Laboratory, or the lab of your choice. Make sure the lab uses the correct testing methods for your soil. An example is using the Olsen bicarbonate test for accurate phosphorus levels in high pH soils.
- **Banded phosphate (MAP/40 rock/etc.) with or nearby the seed is recommended for optimum seedling health.** If banding phosphate has not been a common practice in your operation, consider trying 50 lb/acre of actual product on a few drill-fills next to your usual planting practice and see the difference for yourself.
- **Scout your fields throughout the season.** Noticing issues as they occur can help tremendously in avoiding bigger problems later in the season. If you don't have the time to scout all your acres, consider hiring a consultant to monitor a few fields and/or consult with your local CSU Extension agronomy agent for assistance.
- **Although tempting, do not try to spray for wheat stem sawfly.** There are no effective insecticides for WSS at this time.
- **Crop rotation is imperative to help control diseases and pests in wheat.** When considering rotational options, keep in mind that rotating to broadleaf crops is the best way to combat disease and weed problems.

Small Grain Forage Trial Results

Sally Jones-Diamond, Kat Caswell, and Katie Russell

The 2023-2024 growing season was the third year of testing winter annual forages as a potential dual-purpose crop. There is little external information available on the quality and yield of forage for dual-purpose wheats as they have not been widely grown in our region. It is critical to possess local information about wheat varieties that have favorable forage characteristics with a potential for grain production and vice versa.

Testing Methods:
Entries were planted in small plots (6' by 30') at four dryland locations: Akron, Burlington, Orchard, and Yellow Jacket. Each site had a minimum of six wheat varieties, up to twelve. The six core varieties tested at all sites were Ray, Willow Creek, MTF1435, TAM 204, OK Corral, and Amplify SF. Orchard had two additional varieties, AP Baldy and SY Monument. At Akron, three additional wheat varieties (AP Baldy, SY Monument, and Cash) were tested, along with a triticale (719 Flex), and two forage hybrid rye lines (KWS Aviator and KWS Progas), for a total of twelve entries.

Forage sub-samples were cut from the center of the plots in May or June as each variety reached the early heading stage to determine forage yield and quality, with exception to Yellow Jacket where all varieties were sampled the same day. Forage wet and dry weights were obtained and used to calculate dry matter yield. Hay quality information based on NIR analyses was done by Dairyland Laboratories in Acadia, WI. The remainder of the plots were harvested for grain (yield area adjusted to account for forage sampling), and grain test weight and protein analyses were performed.

Yield, test weight, and dry matter yield values were statistically analyzed, and least significant differences are provided under each location table to compare entries within a location.

Results:
We harvested forage and grain from three of the four sites (Burlington lost to drought). Forage dry matter yield, harvest moisture, and quality, along with grain yield and quality from the three locations are shown on the next page.

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2024 Dryland Winter Forage Variety Performance Trials at Akron, Orchard, and Yellow Jacket

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Akron

			Forage Harvest			Grain Harvest			Forage Quality[a]								
Brand/Source	Variety	Forage Species[b]	Dry Matter Yield	Moisture	Harvest Date	Yield	Test Weight	Protein	CP	RFQ	aNDFom	NDFD30	NDFD240	TDN	NEL	NEG	Milk/Ton
			ton/ac	% at harvest		lb/ac	lb/bu	percent	percent						Mcal/cwt	Mcal/cwt	lb/ton
TriCal	719 Flex Triticale	T	**5.5**	75	18-May	3676	43	13	10.5	141	58	59	75	60	61	33	2725
Montana State Univ.	Cash	W	4.7	74	28-May	3095	50	13	10.5	160	54	58	74	63	66	37	3007
Montana State Univ.	MTF1435	W	4.6	74	28-May	3809	51	13	10.0	152	56	60	76	61	64	35	2865
AgriPro	AP Baldy	W	4.3	72	28-May	3922	55	12	9.6	155	51	56	74	64	67	36	3030
AgriPro	SY Monument	W	3.7	71	24-May	3463	56	12	10.9	170	48	58	73	65	69	40	3207
PlainsGold	Ray	W	3.7	73	31-May	4112	51	13	9.3	153	51	55	75	65	67	36	3028
KWS Cereals	KWS AVIATOR	HR	3.7	80	13-May	3945	53	10	12.0	172	54	62	78	63	67	41	3114
KWS Cereals	KWS PROGAS	HR	3.5	79	13-May	**4979**	53	10	10.6	161	58	61	77	61	65	38	2990
Oklahoma Genetics, Inc	OK Corral	W	3.5	70	23-May	4343	54	12	11.2	188	48	67	80	66	72	46	3452
Watley Seed	TAM 204	W	3.2	73	18-May	3876	52	12	10.8	186	46	63	77	67	72	45	3419
PlainsGold	Amplify SF	W	3.1	75	18-May	4468	**59**	11	9.8	155	50	59	75	65	66	37	3007
Montana State Univ.	Willow Creek	W	-	-	-	2045	53	15	11.2	146	54	61	75	61	63	36	2818
		Average	3.9	74	22-May	3811	52	12	10.5	162	52	60	76	63	66	38	3055
		LSD (0.30)[c]	0.5			272	1										
		LSD (0.05)[c]	1.0			528	2										
		Coefficient of Variation (CV)	9.6			5.3	2.0										

Orchard

			Forage Harvest			Grain Harvest			Forage Quality[a]								
Brand/Source	Variety	Forage Species[b]	Dry Matter Yield	Moisture	Harvest Date	Yield	Test Weight	Protein	CP	RFQ	aNDFom	NDFD30	NDFD240	TDN	NEL	NEG	Milk/Ton
			ton/ac	% at harvest		lb/ac	lb/bu	percent	percent						Mcal/cwt	Mcal/cwt	lb/ton
Montana State Univ.	MTF1435	W	**3.8**	66	31-May	2806	56	14.0	16.1	179	48	66	81	68	68	44	3199
PlainsGold	Ray	W	**3.7**	67	31-May	2904	52	13.7	14.2	164	50	65	82	66	63	38	2865
PlainsGold	Amplify SF	W	3.3	69	20-May	**3111**	**58**	12.7	15.9	197	48	70	84	68	71	49	3425
AgriPro	AP Baldy	W	3.1	70	23-May	**3005**	**58**	13.3	14.7	214	46	73	86	70	74	52	3674
Oklahoma Genetics, Inc	OK Corral	W	3.1	71	20-May	**3042**	51	13.4	17.0	192	47	70	84	69	71	49	3443
Montana State Univ.	Willow Creek	W	2.9	67	31-May	1205	54	15.7	16.7	162	49	62	78	66	65	41	2995
AgriPro	SY Monument	W	2.8	73	20-May	**3248**	56	12.2	17.9	201	46	72	85	68	72	51	3494
Watley Seed	TAM 204	W	2.5	72	20-May	**3085**	52	13.4	15.0	189	48	67	82	67	70	46	3312
		Average	3.1	69	24-May	2801	55	13.6	15.9	187	48	68	83	68	69	46	3301
		LSD (0.30)[c]	0.4			251	0.7										
		LSD (0.05)[c]	0.8			500	1.4										
		Coefficient of Variation (CV)	7.9			8.8	2.0										

Yellow Jacket

			Forage Harvest			Grain Harvest			Forage Quality[a]								
Brand/Source	Variety	Forage Species[b]	Dry Matter Yield	Moisture	Harvest Date	Yield	Test Weight	Protein	CP	RFQ	aNDFom	NDFD30	NDFD240	TDN	NEL	NEG	Milk/Ton
			ton/ac	% at harvest		lb/ac	lb/bu	percent	percent						Mcal/cwt	Mcal/cwt	lb/ton
Watley Seed	TAM 204	W	**1.7**	60	6-Jun	-	-	-	11.7	163	50	61	79	66	66	38	3024
PlainsGold	Amplify SF	W	**1.7**	59	6-Jun	-	-	-	12.0	188	53	68	83	66	70	46	3349
Oklahoma Genetics, Inc	OK Corral	W	**1.7**	58	6-Jun	-	-	-	12.7	182	49	63	80	67	70	43	3279
Montana State Univ.	MTF1435	W	1.6	65	6-Jun	-	-	-	11.6	166	53	63	77	63	65	39	2993
PlainsGold	Ray	W	1.4	67	6-Jun	-	-	-	14.5	220	45	78	89	69	75	54	3733
Montana State Univ.	Willow Creek	W	1.3	66	6-Jun	-	-	-	14.9	182	45	66	81	67	68	44	3225
		Average	1.5	62	6-Jun				12.9	184	49	66	82	66	69	44	3267
		LSD (0.30)[c]	0.1														
		LSD (0.05)[c]	0.2														
		Coefficient of Variation (CV)	8.7														

[a]All forage quality analyses results are dry basis values. CP=crude protein; RFQ=relative feed quality; aNDFom=ash free neutral detergent fiber; NDFD30=neutral detergent fiber digestibility at 30 hours; NDFD240=neutral detergent fiber digestibility at 240 hours;TDN=total digestible nutrients, NEL=net energy for lactation; NEG=net energy gain; and Milk/ton=predicted amount of milk produced per ton of dry matter calculated using MILK2013.

[b]Forage Species: HR=Hybrid Rye, T=Triticale, and W=Wheat

[c]If the difference between two variety yields equals or exceeds the LSD value, the difference is significant. Farmers selecting a variety based on yield should use the LSD (0.30) to protect from false negative decisions. Companies or researchers may be interested in the LSD (0.05) to avoid false positive conclusions.

Trials were harvested for grain on July 2 (Orchard), and July 15 (Akron).

Description of Winter Wheat Varieties in Eastern Colorado Dryland and Irrigated Trials (2024-2025)

Name/Class/Pedigree	Origin	HD	HT	SS	COL*	YR	LR	SR	WSMV**	YD**	WSS+	TW	PRO++	MILL	BAKE	Comments
Amplify SF Hard red winter Bearpaw/Antero//Antero	CSU 2021	6	7	4	7	6	3	2	8	6	1	3	4	3	6	CSU release (2021), marketed by PlainsGold. Medium height, medium maturity. Carries the semi-solid stem trait (17 out of 25 rating) for partial resistance to the wheat stem sawfly. Certified seed only.
AP Bigfoot Hard red winter Undisclosed	AgriPro 2022	4	5	3	3	6	2	2	4	2	6	3	4	4	6	Agripro release (2021). First entered in CSU variety trials in 2022. Early to med-early variety with very good test weight and WSMV tolerance.
AP Solid Hard red winter Undisclosed	AgriPro 2021	7	3	3	5	8	6	5	5	2	1	2	2	3	5	Agripro release (2021). First entered in CSU variety trials in 2020. Medium-late semi-solid stem variety for use in managing wheat stem sawfly. Very good test weight and straw strength.
AP Sunbird Hard red winter Undisclosed	AgriPro 2023	3	4	4	5	7	2	5	3	1	9	4	2	2	4	AgriPro release (2024). First entered in CSU variety trials in 2023. Early to medium early variety with moderately strong WSMV resistance. Very good milling and baking qualities.
AR Iron Eagle 22AX Hard red winter Undisclosed	Armor Seed 2023	1	2	4	2	4	--	--	5	2	--	4	7	--	--	Armor Seed release (2023). First entered in CSU variety trials in 2025. Dual-purpose variety for grain or grazing. Good straw strength and test weight.
AR Turret 25 Hard red winter Undisclosed	Armor Seed 2023	5	5	5	3	3	3	3	9	7	--	3	3	--	--	Armor Seed release (2023). First entered in CSU variety trials in 2025. Medium maturity. Moderately resistant to stripe rust. Very good test weight and protein.
Avery Hard red winter TAM 112/Byrd	CSU 2015	5	7	5	6	6	8	8	1	1	6	4	6	3	3	CSU release (2015), marketed by PlainsGold. Doubled haploid-derived line, similar to Byrd with higher yield potential, larger kernels and slightly improved quality. Carries wheat curl mite resistance from TAM 112 parent. Susceptible to stripe rust.
Breck Hard white winter Denali/HV9W07-482W//Antero	CSU 2017	5	5	5	8	8	5	2	4	1	7	4	2	2	4	CSU release (2017), marketed by PlainsGold in CWRF-Ardent Mills UltraGrain Premium Program. Good stripe rust resistance, sprouting tolerance, straw strength, grain protein deviation, and quality. Very high test weight, lower polyphenol oxidase (PPO) activity for improved whole grain bread and noodle quality. Certified seed only.
Byrd Hard red winter TAM 112/CO970547-7	CSU 2011	4	6	5	5	8	7	8	4	3	7	5	5	3	3	CSU release (2011), marketed by PlainsGold. Excellent drought tolerance (from TAM 112) and quality. Average test weight and straw strength. Moderately susceptible to stripe rust. Carries wheat curl mite resistance from TAM 112 parent.

Column Key - heading date (HD), plant height (HT), straw strength (SS), coleoptile length (COL), stripe rust resistance (YR), leaf rust resistance (LR), stem rust resistance (SR), wheat streak mosaic virus tolerance (WSMV), yellowing disease (YD), wheat stem sawfly tolerance (WSS), test weight (TW), protein (PRO), milling (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/long. A priority is given to data collected in Colorado. Regional data or developer input is utilized when Colorado specific data is unavailable.

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** WSMV and YD ratings are based on field evaluations in Colorado under pressure from wheat curl mite transmitted viruses. Scores may reflect both resistance to the wheat curl mite and resistance to mite-transmitted viruses. Lines susceptible to YD have been shown to contain high levels of *Triticum mosaic* virus.

+WSS ratings are based on field evaluation of tolerance to wheat stem sawfly cutting in Colorado. Values do not represent the level of stem solidness expression. See comments for solidness rating.

++ PRO ratings represent “grain protein deviation” (relative grain protein level accounting for differences in grain yield).

Description of Winter Wheat Varieties in Eastern Colorado Dryland and Irrigated Trials (2024-2025)

Name/Class/Pedigree	Origin	HD	HT	SS	COL*	YR	LR	SR	WSMV**	YD**	WSS+	TW	PRO++	MILL	BAKE	Comments
Byrd CL Plus Hard red winter CO06072/4*Byrd	CSU 2018	5	8	5	6	5	5	8	3	2	4	5	6	4	5	CSU release (2018), marketed by PlainsGold. Two-gene Clearfield wheat in Byrd background. Highly similar to Byrd with exception of tolerance to Beyond herbicide. Has shown some non solid-stem based tolerance to wheat stem sawfly. Certified seed only.
Canvas Hard red winter Denali/Antero//Byrd	CSU 2018	5	4	2	6	3	6	2	2	2	4	4	4	2	3	CSU release (2018), marketed by PlainsGold. Hard red winter, medium maturing, medium-short, good straw strength. Good stripe and stem rust resistance and carries wheat curl mite resistance from Byrd parent. Good test weight and milling and baking quality.
CO18042RA Hard red winter (AF28/Byrd//AF26/Byrd)//2*Byrd/(AF28/Byrd//AF10 M3/2*Byrd)//2*Byrd/Byrd//(AF10 M3/2*Byrd//AF26/Byrd)//2*Byrd/(AF28/Byrd//AF26/Byrd)//2*Byrd/Langin	CSU EXP	3	7	7	5	3	8	7	2	3	5	5	6	3	3	CSU release (2024). Three gene CoAXium wheat for winter annual grassy weed control. Acidic soil tolerance. Wheat curl mite resistance from Byrd. Very good milling and baking quality. Foundation seed currently in production.
CO19410R Hard red winter Avery/CO07W722-F5//CO11D1316W	CSU EXP	5	4	5	5	4	8	2	1	1	5	3	4	3	2	CSU experimental line, first entered into the CSU trials in 2023. Performed at 110% of the trial mean for yield in 2023. Resistant to the wheat curl mite which vectors the mosaic virus complex. Moderate resistance to stripe rust and good resistance to stem rust. Good milling and baking quality. Potential release in 2025.
CO19D087R Hard red winter CO12D1777/Langin	CSU EXP	3	2	4	3	2	7	2	3	1	7	4	4	4	3	CSU release (2024), first entered into the CSU trials in 2023. Performed at 115% of the trial mean for yield in southeastern Colorado in 2023. Resistant to the wheat curl mite which vectors the mosaic virus complex. Good resistance to stripe rust and stem rust. Good milling and baking quality. Acid soil tolerant. Foundation seed available in 2025.
CO200037R Hard red winter Canvas//X170868/Canvas	CSU EXP	6	4	3	7	4	5	1	1	1	3	4	4	3	4	CSU release (2024), first entered into the CSU trials in 2023. Similar performance as Canvas. Resistant to the wheat curl mite and contains a new gene, *Wsm3,* with broad resistance against the mosaic virus complex. Moderate resistance to stripe rust and stem rust. Good milling and baking quality. Acid soil tolerant. Foundation seed available in
CO20022RC Hard red winter CO14079RC/CO12D075	CSU EXP	5	5	4	6	5	--	--	2	1	7	4	7	1	4	CSU experimental line, first entered in the CSU trials in 2024. Two-gene Clearfield. Resistant to wheat curl mite which vectors the mosaic virus complex. Potential release in 2025 or 2026.
CO20D108R Hard red winter CO13D1320/Valley//Canvas	CSU EXP	6	5	3	7	4	5	1	1	1	4	6	7	3	3	CSU experimental line, first entered into the CSU trials in 2023. Performed at 106% of the trial mean for yield in 2023. Resistant to the wheat curl mite which vectors the mosaic virus complex. Moderate resistance to stripe rust and good resistance to stem rust. Good milling and excellent baking quality. Potential release in 2025.
CO20SFD019R Hard red winter CO16SFD020/CO16SF029	CSU EXP	2	4	4	3	7	--	--	6	2	2	4	5	2	5	CSU experimental line, first entered into the CSU trials in 2024. Semi-solid stem (15 out of 25) for partial resistance to wheat stem sawfly.

Column Key - heading date (HD), plant height (HT), straw strength (SS), coleoptile length (COL), stripe rust resistance (YR), leaf rust resistance (LR), stem rust resistance (SR), wheat streak mosaic virus tolerance (WSMV), yellowing disease (YD), wheat stem sawfly tolerance (WSS), test weight (TW), protein (PRO), milling (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/long. A priority is given to data collected in Colorado. Regional data or developer input is utilized when Colorado specific data is unavailable.

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++ PRO ratings represent “grain protein deviation” (relative grain protein level accounting for differences in grain yield).

Description of Winter Wheat Varieties in Eastern Colorado Dryland and Irrigated Trials (2024-2025)

Name/Class/Pedigree	Origin	HD	HT	SS	COL*	YR	LR	SR	WSMV**	YD**	WSS+	TW	PRO++	MILL	BAKE	Comments
CO20SFD020R Hard red winter CO16SFD020/CO16SF029	CSU EXP	6	3	4	2	5	--	--	3	1	2	4	7	2	8	CSU experimental line, first entered into the CSU trials in 2024. Semi-solid stem (15 out of 25) for partial resistance to wheat stem sawfly. On foundation increase for potential release in 2025.
CO21SF191RA Hard red winter CO15SFD088/Battle AX//CO16SF075	CSU EXP	7	5	5	7	3	--	--	5	2	2	6	3	4	9	CSU experimental line, first entered into the CSU trials in 2024. Semi-solid stem (14 out of 25) for partial resistance to wheat stem sawfly. CoAXium wheat for winter annual grassy weed control. On foundation increase for potential release in 2025.
CO21SF263RA Hard red winter CO15SFD088/Battle AX//CO16SF075	CSU EXP	8	5	5	7	3	--	--	4	2	2	6	3	4	9	CSU experimental line, first entered into the CSU trials in 2024. Semi-solid stem (14 out of 25) for partial resistance to wheat stem sawfly. CoAXium wheat for winter annual grassy weed control. On foundation increase for potential release in 2025.
CP7017AX Hard red winter Undisclosed	Croplan 2020	4	2	6	3	5	4	1	3	2	7	4	6	3	7	CROPLAN by WinField United release (2020). First entered into CSU trials in 2020. CoAXium wheat for winter annual grassy weed control. Strong yield potential, strong drought tolerance, tolerates acid soils and resistant to soilborne mosaic virus. Certified seed only.
CP7220 Hard red winter Undisclosed	Croplan 2024	6	5	--	3	4	4	--	--	3	5	6	3	3	8	CROPLAN by WinField United release (2024). First entered into the CSU trials in 2024. Adapted to Northern Central Plains, with excellent test weight.
CP7266AX Hard red winter Undisclosed	Croplan EXP	5	5	5	6	2	1	5	--	--	5	5	6	3	6	CROPLAN by WinField United release (2021). First entered into CSU trials in 2022. CoAXium wheat for winter annual grassy weed control. Medium height and maturity, good resistance to stripe rust and leaf rust.
CP7869 Hard red winter Undisclosed	Croplan 2017	6	4	4	5	2	1	1	7	7	8	4	5	2	6	CROPLAN by WinField United release (2017). First entered into CSU trials in 2020. High yield potential, strong straw, good test weight. Good resistance to leaf, stem, and stripe rusts.
CP7909 Hard red winter Undisclosed	Croplan 2018	4	5	5	5	7	5	5	8	7	7	5	7	3	6	CROPLAN by WinField United release (2018). First entered into CSU trials in 2020 Excellent yields and higher protein potential with very good winterhardiness, broad adaptation, and excellent soilborne mosaic resistance.
Crescent AX Hard red winter (AF28/Byrd)//(AF10/2*Byrd)	CSU 2018	3	7	8	5	5	6	--	2	2	6	4	7	3	2	CSU release (2018), marketed by PlainsGold. CoAXium wheat for winter annual grassy weed control. Approximately 66% Byrd and 34% Hatcher parentage. Earlier and much improved yield and test weight relative to Incline AX. Intermediate reaction to stripe rust and carries wheat curl mite resistance from Byrd parent. Certified seed only.

Column Key - heading date (HD), plant height (HT), straw strength (SS), coleoptile length (COL), stripe rust resistance (YR), leaf rust resistance (LR), stem rust resistance (SR), wheat streak mosaic virus tolerance (WSMV), yellowing disease (YD), wheat stem sawfly tolerance (WSS), test weight (TW), protein (PRO), milling (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/long. A priority is given to data collected in Colorado. Regional data or developer input is utilized when Colorado specific data is unavailable.

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Description of Winter Wheat Varieties in Eastern Colorado Dryland and Irrigated Trials (2024-2025)

Name/Class/Pedigree	Origin	HD	HT	SS	COL*	YR	LR	SR	WSMV**	YD**	WSS+	TW	PRO++	MILL	BAKE	Comments
Fortify SF Hard red winter Byrd/Bearpaw//Byrd	CSU 2019	4	6	6	5	6	7	4	3	1	2	2	5	3	6	CSU release (2019), marketed by PlainsGold. Medium height, medium maturity. Carries wheat curl mite resistance from Byrd parent and semi-solid stem trait (13 out of 25 rating) for partial resistance to the wheat stem sawfly. Certified seed only.
Guardian Hard red winter Antero/Snowmass//Byrd	CSU 2019	6	7	6	7	3	4	2	4	5	6	3	2	3	3	CSU release (2019), marketed by PlainsGold. Medium height, medium maturity. Excellent resistance to WSMV due to combination of resistance to wheat curl mite and the virus itself via *Wsm2*. Good combined resistance to all three rusts, good test weight, good milling and baking quality, high grain protein deviation. Certified seed only.
Kivari AX Hard red winter (AF28/Byrd)//(AF10/2*Byrd)	CSU 2020	5	6	8	6	6	8	5	6	5	5	6	8	3	3	CSU release (2020), marketed by PlainsGold. CoAXium wheat for winter annual grassy weed control. Higher yielding and slightly later maturing than Crescent AX. Intermediate reaction to stripe rust and carries wheat curl mite resistance from Byrd parent. Certified seed only.
KS Big Bow Hard white winter KS050223M-2/KS11W15	KS-Manhattan 2022	5	5	4	3	4	--	2	2	5	--	5	4	4	5	KSU release (2022), marketed by the Kansas Wheat Alliance. First tested in 2023. Medium maturity and medium height. Resistant to WSMV.
KS Bill Snyder Hard red winter KS11HW15-4-1/KS060476-M-6	KS-Hays 2023	5	3	1	4	4	2	3	2	2	--	5	--	--	--	KSU release (2023), marketed by Kansas Wheat Alliance. Medium maturity with moderate stripe rust resistance. Average test weight. Certified seed only (CSO) variety.
KS Homesteader CL+ Hard red winter KS14-50809/Brawl CL Plus	KS-Hays 2024	7	7	4	--	2	7	4	2	3	--	4	--	--	--	KSU release (2023), marketed by Kansas Wheat Alliance. Two-gene Clearfield wheat. Medium-late maturity. Resistant to stripe rust and has higher temperature resistance to WSMV. Certified seed only (CSO) variety.
KS Territory Hard red winter KS11HW15/TX10A001006	KS-Hays 2022	5	4	3	4	2	4	4	3	2	6	5	4	5	7	KSU release (2022), marketed by the Kansas Wheat Alliance. First entered in the CSU trial in 2023. Medium maturity, excellent straw strength, and resistant to WSMV and Triticum mosaic virus (TriMV).
Langin Hard red winter CO050270/Byrd	CSU 2016	2	3	8	3	2	6	8	4	2	6	5	6	4	3	CSU release (2016), marketed by PlainsGold. Early maturing semidwarf. Good drought stress tolerance and winterhardiness, stripe rust resistance, and quality. Medium coleoptile. Carries wheat curl mite resistance from Byrd parent. Very high yield potential for irrigation, but straw strength requires use of growth regulator.
LCS Atomic AX Hard red winter Undisclosed	Limagrain 2019	3	4	4	4	3	2	9	--	7	7	7	5	4	5	Limagrain release (2019), first entered in CSU Variety Trials in 2021. CoAXium wheat for winter annual grassy weed control. Excellent straw strength and resistance to stripe rust. Certified seed only.

Column Key - heading date (HD), plant height (HT), straw strength (SS), coleoptile length (COL), stripe rust resistance (YR), leaf rust resistance (LR), stem rust resistance (SR), wheat streak mosaic virus tolerance (WSMV), yellowing disease (YD), wheat stem sawfly tolerance (WSS), test weight (TW), protein (PRO), milling (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/long. A priority is given to data collected in Colorado. Regional data or developer input is utilized when Colorado specific data is unavailable.

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Description of Winter Wheat Varieties in Eastern Colorado Dryland and Irrigated Trials (2024-2025)

Name/Class/Pedigree	Origin	HD	HT	SS	COL*	YR	LR	SR	WSMV**	YD**	WSS+	TW	PRO++	MILL	BAKE	Comments
LCS Helix AX Hard red winter Undisclosed	Limagrain 2019	4	4	4	6	5	4	2	--	--	8	3	8	4	4	Limagrain release (2018), first entered in CSU Variety Trials in 2020. CoAXium wheat for winter annual grassy weed control. Broad adaptation, good resistance to stem rust and Fusarium head blight. Certified seed only.
LCS Julep Hard red winter T153/LCS Mint	Limagrain 2020	5	5	5	4	2	4	4	--	--	6	4	1	3	3	Limagrain release (2020). First entered in CSU variety trials in 2020. Medium maturity variety with very good stripe rust resistance and intermediate stem and leaf rust resistance. Adatped across the Central Plains. Good WSMV tolerance.
LCS Mojo Hard red winter Undisclosed	Limagrain 2023	5	7	4	2	9	--	--	2	--	--	4	4	5	5	Limagrain release (2023). Medium maturity with good straw strength. Strong resistance to WSMV. Good test weight and protein.
LCS Radar Hard red winter Undisclosed	Limagrain 2024	2	5	4	3	1	2	5	3	1	8	5	3	3	4	Limagrain release (2024). First entered into the CSU trials in 2024. Broadly adapted across the Great Plains, very good to excellent stripe and leaf rust resistance.
LCS Steel AX Hard red winter LCH13KSDH-20-87/ACC 7-38	Limagrain 2021	4	4	3	4	5	2	8	--	7	5	4	3	3	5	Limagrain release (2021). First entered into the trials in 2023. CoAXium wheat for winter annual grass weed control. Broad adaptation, very good leaf rust resistance and excellent straw strength. Certified seed only.
LCS White Lightning Hard white winter Undisclosed	Limagrain 2024	4	5	9	6	1	3	9	--	3	5	5	5	2	5	Limagrain release (2024). First entered into the CSU trials in 2024. Hard white wheat. Adapted to western Great Plains, With excellent resistance to stripe rust. Certified seed only.
Monarch Hard white winter CO07W722-F5/Snowmass//CO07W722-F5	CSU 2018	6	3	3	6	4	5	2	4	1	3	4	7	4	4	CSU release (2018), marketed by PlainsGold. Hard white winter with excellent straw strength and very high irrigated yield potential. Good stripe rust resistance. Quality more similar to Breck, but very low PPO. Certified seed only.
MT WarCat Hard red winter Loma/AAC Gateway//Loma	MT 2022	8	4	--	--	1	6	4	--	4	--	6	4	3	1	Montana State University release (2022). Late maturity. Semi-solid stem for resistance to WSS. Excellent resistance to stripe rust. Average test weight and above-average protein. Certified seed only (CSO) variety.
NHH17612 Hard red winter Brawl CL Plus/NHH09655	NE EXP	6	7	4	3	3	--	4	--	--	--	5	5	3	4	University of Nebraska experimental line. First entered into the CSU irrigated trials in 2024.

Column Key - heading date (HD), plant height (HT), straw strength (SS), coleoptile length (COL), stripe rust resistance (YR), leaf rust resistance (LR), stem rust resistance (SR), wheat streak mosaic virus tolerance (WSMV), yellowing disease (YD), wheat stem sawfly tolerance (WSS), test weight (TW), protein (PRO), milling (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/long. A priority is given to data collected in Colorado. Regional data or developer input is utilized when Colorado specific data is unavailable.

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+WSS ratings are based on field evaluation of tolerance to wheat stem sawfly cutting in Colorado. Values do not represent the level of stem solidness expression. See comments for solidness rating.

++ PRO ratings represent “grain protein deviation” (relative grain protein level accounting for differences in grain yield).

Description of Winter Wheat Varieties in Eastern Colorado Dryland and Irrigated Trials (2024-2025)

Name/Class/Pedigree	Origin	HD	HT	SS	COL*	YR	LR	SR	WSMV**	YD**	WSS+	TW	PRO++	MILL	BAKE	Comments
NHH19668 Hard red winter OK09915C/NH11565	UNL EXP	3	2	5	5	--	--	--	--	3	7	4	4	3	8	University of Nebraska experimental line. First entered into the CSU trials in 2024.
Ray Hard red winter Yellowstone*2/98X168E1	MT State 2018	9	9	7	3	2	--	8	--	3	5	8	4	4	2	Forage line available through the PlainsGold Brand with improved grain yield compared to other forage varieties.
Sheridan Hard red winter CO12D906/CO11D1353//Monarch	CSU 2023	5	6	4	8	2	5	1	5	2	7	3	3	3	3	CSU release (2023), not yet commercially available. Medium maturity and height and moderate straw strength. Very long coleoptile. Good overall yield performance in irrigated and dryland environments. Good resistance to stripe rust, stem rust, and moderate for leaf rust. Excellent grain protein deviation. Good milling and baking quality.
Snowmass 2.0 Hard white winter CO07W722-F5/Snowmass//Brawl CL Plus	CSU 2018	4	4	4	5	5	5	1	4	3	5	5	4	3	1	CSU release (2018), marketed by PlainsGold in CWRF-Ardent Mills Ultragrain Premium Program. Hard white wheat, quality profile very similar to Snowmass but low PPO and better grain protein deviation. Good stripe and stem rust resistance and wheat streak mosaic virus resistance. Good straw strength, good test weight. Certified seed only.
Steamboat Hard red winter TAM 114/Antero//Byrd	CSU 2020	6	9	6	7	3	3	3	1	5	5	3	6	3	4	CSU release (2020), marketed by Crop Research Foundation of Wyoming. Medium maturing, tall, marginal straw strength. Good resistance to all three rusts and carries resistance to the wheat curl mite from Byrd. Good test weight and milling and baking quality.
SY Wolverine Hard red winter Everest/Platte//SY Wolf	Agripro 2019	4	2	2	5	7	2	2	4	--	6	5	2	3	5	Agripro release (2019), first entered in CSU trials in 2019. Good overall disease resistance, good straw strength. Similar to SY Wolf in reaction to wheat streak mosaic virus. Good test weight. Certified seed only.
Telluride Hard white winter CO12D906/CO07W722-F5	CSU 2023	4	4	2	4	8	6	1	4	1	7	4	2	3	3	CSU release (2023), not yet commercially available. Hard white winter wheat. Mid to early maturity and slightly short stature. Excellent straw strength and overall yield performance in irrigated and dryland environments. Excellent grain protein deviation. Very good milling and baking quality.
Valley Hard white winter CO07W722-F5/Antero//Snowmass	CSU 2022	5	7	4	3	3	6	4	4	1	3	7	4	4	2	CSU release (2018) marketed by PlainsGold in CWRF-Ardent Mills Ultragrain Premium Program. White-seeded with excellent quality and good pre-harvest sprouting tolerance. Moderately resistant to stripe, leaf, and stem rust. Medium height and medium maturity.
WB4444 Hard red winter Undisclosed	Westbred 2022	5	5	2	--	4	6	4	6	4	--	7	1	4	4	WestBred release (2022). Medium maturity. Solid solid stem for resistance to WSS. Excellent protein and good stripe rust resistance. Certified seed only (CSO) variety.

Column Key - heading date (HD), plant height (HT), straw strength (SS), coleoptile length (COL), stripe rust resistance (YR), leaf rust resistance (LR), stem rust resistance (SR), wheat streak mosaic virus tolerance (WSMV), yellowing disease (YD), wheat stem sawfly tolerance (WSS), test weight (TW), protein (PRO), milling (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/long. A priority is given to data collected in Colorado. Regional data or developer input is utilized when Colorado specific data is unavailable.

* 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.

** WSMV and YD ratings are based on field evaluations in Colorado under pressure from wheat curl mite transmitted viruses. Scores may reflect both resistance to the wheat curl mite and resistance to mite-transmitted viruses. Lines susceptible to YD have been shown to contain high levels of *Triticum mosaic* virus.

+WSS ratings are based on field evaluation of tolerance to wheat stem sawfly cutting in Colorado. Values do not represent the level of stem solidness expression. See comments for solidness rating.

++ PRO ratings represent "grain protein deviation" (relative grain protein level accounting for differences in grain yield).

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Description of Winter Wheat Varieties in Eastern Colorado Dryland and Irrigated Trials (2024-2025)

Name/Class/Pedigree	Origin	HD	HT	SS	COL*	YR	LR	SR	WSMV**	YD**	WSS+	TW	PRO++	MILL	BAKE	Comments
WB4733CLP Hard red winter Undisclosed	Westbred 2022	7	2	3	6	2	3	6	6	7	--	7	4	--	--	WestBred release (2022). Two-gene Clearfield wheat. Medium-late maturity. Very good to excellent resistance to leaf and stripe rusts. Certified seed only (CSO) variety.
Whistler Hard red winter CO08W218/Snowmass//Byrd	CSU 2018	7	9	9	8	3	6	1	2	1	6	6	5	4	3	CSU release (2018), marketed by PlainsGold. Hard red winter, later maturing, tall, marginal straw strength. Good stripe and stem rust resistance and carries wheat curl mite resistance from Byrd parent. Very good milling and baking quality.
Windom SF Hard white winter Warhorse/Breck//CO12D1028	CSU 2022	4	2	4	7	6	8	1	7	4	1	3	4	3	2	CSU release (2021), marketed by PlainsGold in CWRF-Ardent Mills Ultragrain Premium Program. White-seeded with strong mixing and baking properties. Semi-solid stem (16/25) for partial resistance to the wheat stem sawfly. Wsm2 for resistance to wheat streak mosaic virus. Good test weight, long coleoptile, tolerance to lower pH. Certified seed

Column Key - heading date (HD), plant height (HT), straw strength (SS), coleoptile length (COL), stripe rust resistance (YR), leaf rust resistance (LR), stem rust resistance (SR), wheat streak mosaic virus tolerance (WSMV), yellowing disease (YD), wheat stem sawfly tolerance (WSS), test weight (TW), protein (PRO), milling (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/long. A priority is given to data collected in Colorado. Regional data or developer input is utilized when Colorado specific data is unavailable.

* 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.

** WSMV and YD ratings are based on field evaluations in Colorado under pressure from wheat curl mite transmitted viruses. Scores may reflect both resistance to the wheat curl mite and resistance to mite-transmitted viruses. Lines susceptible to YD have been shown to contain high levels of *Triticum mosaic* virus.

+WSS ratings are based on field evaluation of tolerance to wheat stem sawfly cutting in Colorado. Values do not represent the level of stem solidness expression. See comments for solidness rating.

++ PRO ratings represent “grain protein deviation” (relative grain protein level accounting for differences in grain yield).

Saving Seed of PVP Protected Varieties

Laura Pottorff

The advantages of choosing certified seed varieties are numerous, especially for growers who battle increased levels of:

- Insects and mites that cannot be adequately controlled with insecticides like wheat stem sawfly, wheat curl mite and other virus vectors
- Disease pressures with no available chemical control or seed treatment solutions like plant pathogenic viruses
- Grassy weeds or other inseparable seed crop contaminants in wheat fields without herbicide selectivity such as volunteer rye and jointed goatgrass in wheat

Plant breeders continue to develop varieties with new traits; they provide new solutions to developing pest, disease, environmental, weed and other yield-reducing issues. What's the cost? Many of these high-quality seed varieties come with a slightly higher price. Many also come with restrictions on the ability to save seed and certainly prohibitions on selling saved seed. The owner of a plant variety has exclusive rights to control the production and distribution of the varieties they develop. This is like a patent and the Plant Variety Protection Act (PVP) is a law established to protect the investment made by plant breeders and to facilitate future research and development. What benefits the plant breeder, benefits the farmer.

There are three types of protection to be aware of prior to purchasing a Certified Seed:

PVP[1]

- All varieties must be sold by variety name.
- Sales of farmer-saved seed are prohibited.
- Seed conditioners may be held liable if they clean PVPA protected seed that gets illegally sold.
- Grain may be saved for planting by the grower only.

PVP[2] Title V Option

- Same requirements as PVP, above, and:
  - If this option is elected by the owner, then the seed may only be sold as a class of Certified Seed.
  - Sales of non-certified seed are illegal under Title V of the Federal Seed Act.

Single Use[3] Seed Agreements/Certified Seed Only (CSO)

- Same requirements as PVP and Title V above, and:
  - An additional contractual agreement between the company and the grower where the grower agrees that the seed they purchase is used solely for planting and production of a SINGLE CROP.
  - The grower agrees not to save any grain produced from seed for planting for their own use or for use by any other person or entity.

To help discern which varieties can be saved and which varieties need to be purchased each year, refer to the table below.

[1]**PVP-** Unauthorized propagation is prohibited**. Grain may be saved for planting by the grower only.** Seed must be sold by variety name. Sale of farmer-saved seed is prohibited.			
	WB4418	WB4483	
[2]**PVP + Title V option -** Unauthorized propagation is prohibited**. Grain may be saved for planting by the grower only.** Sale of farmer-saved seed is prohibited. Seed must be sold by variety name. **Seed may only be sold as a class of Certified Seed.**			
Antero	AP BigFoot	AP Everrock	AP Roadrunner
AP Solid	Avery	Breck	Byrd
Canvas	Fortify SF	Guardian	KS Dallas
KS Hamilton	KS Providence	Langin	LCS Julep
LCS Mint	LCS Radar	Monarch	NuGrain
Ray	SY Assure	SY Legend	SY Ovation
SY Wolverine	Whistler		
[3]**Single Use** – All the provisions of PVP and Title V apply**.** In addition**, Seed of these wheat varieties must be purchased every yea**r due to stewardship agreements or exclusive contracts.			
Amplify SF	AP18 AX	Brawl CL+	Byrd CL+
Crescent AX	Kivari AX	KS Bill Synder	KS Homesteader CL+
KS Territory	LCS Atomic AX	LCS Helix AX	NE Prism CLP
Settler CL	Snowmass	Snowmass 2.0	SY Sunrise
WB4347	WB 4422	WB4444	WB4595
WB4733CLP	WB4792	Windom SF	

Wheat Quality Evaluations from the 2024 CSU Dryland and Irrigated Variety Trials

John Stromberger, Esten Mason, Sally Jones-Diamond

Introduction

End-use quality maintenance and improvement is an important objective of virtually all wheat breeding programs. Grain milling and product manufacturing industries have become increasingly sophisticated in both domestic and export markets and, while wheat producers may not always be rewarded for improved functional quality, technological advancements promise to increase the ability of the grain trade to identify and source good quality and discount poor quality wheat.

Breeding for wheat end-use quality is relatively complex in comparison to many other breeding objectives. Quality is a function of variety interacting with climate and agronomic practices and Colorado's harsh and variable climatic conditions often negatively impact quality. Quality assessment is commonly done through evaluation of multiple traits with many underlying genetic factors controlling their expression. Most experimental quality tests only approximate average quality needs of product manufacturers and don't exactly match specific requirements of different wheat product types and processes. For hard winter wheat, high grain protein content is an important criterion for baking quality but may be indicative of varieties with lower yield if yield differences at a given location are not considered (through "grain protein deviation"). Finally, wheat quality testing must accommodate the reality of large sample numbers and small sample sizes that are typical of all wheat breeding programs. Despite these challenges, standard testing methodologies have been developed that are consistent, repeatable, and can be done on large numbers of relatively small samples. These analyses provide reliable assessments of functional quality characteristics for a broad array of potential product types and processes.

Our objective with providing quality data and summaries for entries in the CSU Dryland and Irrigated Variety Trials is to characterize the quality of public and private trial entries that are currently or have the potential to be marketed in Colorado. We hope that the data and resulting ratings will be included among the criteria by which wheat producers choose their varieties. At the very least, we encourage producers to carefully consider avoiding varieties that have lower wheat quality when other agronomically acceptable varieties with better quality are available.

Testing Methodology

In 2024, grain samples were collected from each of the dryland (UVPT) and irrigated (IVPT) variety trial locations. Preliminary quality analyses were carried out to determine suitability of each location for full-scale analyses, with the selection criteria including grain protein content not too far below or above 11.5%, sound grain free of visual defects, and good discrimination among samples at a given location for experimental dough mixing properties (using the Mixograph). In this process of sample selection, the following locations were retained for full scale testing:

UVPT – Akron, Lamar, Sheridan Lake IVPT – Burlington, Fort Collins

Using standard protocols, analyses were done in the CSU Wheat Quality Laboratory on samples from the remaining locations. These tests, reported in the attached tables, include the following:

Milling-Related Traits

- Test weight: obtained by standard methodology on a cleaned sample of the harvested grain.
- Grain protein and protein recovery: obtained using near-infrared reflectance spectroscopy (NIRs) with a Foss NIRS™ DA1650 Feed and Forage analyzer. Grain protein is reported on a

standard 12% moisture basis. High grain protein content is associated with higher water absorption of flours and higher loaf volumes in the bakery. Protein recovery represents the numerical difference between grain and flour protein content and a value closer to zero is most desirable by the milling industry.

- Single kernel characterization system (SKCS): the Perten SKCS 4100 provides data on kernel weight and hardness of a grain sample. 100-300 kernels are analyzed to provide an average value and a measure of variability for each trait. Millers prefer a uniform sample with heavier kernels (>30 grams per 1000 kernels or <15,133 seeds/pound) for improved milling. Hardness should be representative of the hard winter wheat class (60-80 hardness units).
- Flour yield: obtained using a modified Brabender Quadrumat Milling System. Flour yield represents the percentage of straight grade flour obtained from milling a grain sample (approximately one pound). In general, millers prefer high flour extraction values. Due to variation among different milling systems, valid comparison of values from different mills and establishment of a single target value is not possible.

Baking-Related Traits

- Mixograph mixing time and tolerance: obtained using a National Manufacturing Computerized Mixograph. The Mixograph measures the resistance of dough during the mixing process. Bakers generally prefer flours with moderate mixing time requirements (3-6 minutes) and good tolerance to breakdown of the dough with over-mixing (subjective score >3). Some varieties with exceptionally long mixing times (i.e., Snowmass) may not compare favorably with other varieties in conventional evaluations but have unique characteristics that merit handling in an identity-preserved program such as the CWRF Ardent Mills Ultragrain® Premium Program.
- Pup loaf bake test: using a 100-gram straight-dough test, data on bake water absorption, mixing time, loaf volume, and crumb characteristics are obtained. Bakers usually prefer higher water absorption (> 62%), high loaf volume (> 850 cubic centimeters), and higher crumb grain and crumb color scores (score > 3). The crumb grain and color scores are subjective assessments of the color and size, shape, and structure of the small holes in a slice of bread.

Composite Scores

Because none of the traits measured can be used alone to represent overall milling or baking quality, development of a composite score has proven useful to differentiate and characterize overall quality of different samples. The development of a composite score also has the advantage of accounting for differences in environmental conditions from year to year and utilizing all the data generated on the samples collected at a given trial location.

Composite scores are generated through a two-step process. First, each trait is ranked from high to low (or "very good" to "very poor") at individual locations and a score from 1=very good to 9=very bad is assigned to each variety for each trait depending on the optimal orientation of the trait. Second, these individual-trait scores are used to generate a composite score that weights the trait scores by the relative importance of that trait to overall milling or baking quality. The weights that we have used are similar to those developed by the USDA-ARS Hard Winter Wheat Quality Laboratory for the Wheat Quality Council evaluations. These weights are as follows:

Milling – test weight 30%, grain protein content 10%, protein recovery 10%, kernel weight 20%, grain hardness 10%, flour yield 20% (100% total)

Baking – bake absorption 20%, Mixograph mixing time 20%, Mixograph tolerance 20%, loaf volume 20%, crumb color 10%, crumb grain 10% (100% total)

Wheat Milling and Baking Quality Data - 2024 UVPT Akron

* **Bold** indicates superior value, underlined indicates inferior value.

Entry	Test Weight	Grain Protein	SKCS Weight	SKCS Hardness	Flour Yield	Protein Recovery	Bake Absorption	Mixograph Mix Time	Mixograph Tolerance	Loaf Volume	Crumb Color	Crumb Grain	**Milling Score**	**Baking Score**
Amplify SF	57.7	10.6	**26.5**	64.7	70.5	-1.3	59.4	4.40	3	820	3	2	**2**	6
AP Bigfoot	57.9	11.0	**24.7**	63.4	68.8	-1.2	57.7	4.40	2	875	2	2	**2**	6
AP Solid	**60.2**	11.0	**26.7**	73.0	68.7	-0.9	61.6	3.55	3	790	4	3	**2**	5
AP Sunbird	58.6	9.9	**27.1**	60.9	**71.6**	-0.9	59.6	**6.51**	**5**	880	4	4	**1**	**2**
Avery	55.5	9.5	**23.7**	57.4	69.1	-0.8	57.2	4.26	4	865	**5**	3	5	5
Breck	**60.5**	9.7	**25.7**	70.4	70.2	**-0.6**	60.6	4.02	4	850	4	3	**1**	4
Byrd	56.3	10.8	**22.8**	56.7	**71.5**	-1.2	60.6	5.73	**5**	**1020**	3	3	**3**	**1**
Byrd CL Plus	55.2	10.3	**24.4**	56.8	68.9	-1.0	59.9	3.99	4	800	2	2	5	5
Canvas	58.0	10.8	**23.7**	67.1	**72.5**	-1.2	59.7	4.82	4	875	4	3	**1**	4
CO18042RA	55.3	9.8	**24.9**	54.9	69.5	-0.8	58.6	5.97	**5**	890	3	3	5	4
CO19410R	57.8	10.6	**24.1**	67.3	70.9	-0.7	**62.4**	5.09	4	895	4	3	**2**	**3**
CO19D087R	55.6	9.9	**25.7**	54.0	69.2	-1.0	59.7	5.68	**5**	910	4	4	5	**2**
CO200037R	58.6	10.7	**24.6**	67.8	**71.2**	-0.7	61.7	5.56	4	925	1	3	**1**	**3**
CO20022RC	58.7	10.2	**24.1**	68.0	70.7	**-0.5**	59.8	5.17	4	875	4	3	**2**	4
CO20D108R	55.6	9.8	**23.3**	58.7	69.7	-0.7	59.7	**6.94**	3	925	4	4	4	**2**
CO20SFD019R	**59.1**	10.4	**28.4**	53.8	**73.1**	-0.8	61.8	3.09	3	925	**5**	4	**1**	4
CO20SFD020R	56.7	9.8	**24.5**	57.8	69.7	-0.7	56.6	3.95	2	850	4	3	**3**	7
CO21SF191RA	54.5	**11.1**	**24.3**	70.1	67.6	-0.6	60.5	3.09	2	675	2	2	5	8
CO21SF263RA	54.7	**11.5**	**23.5**	69.2	67.7	-0.9	60.4	3.28	2	690	1	1	5	9
CP7017AX	56.6	10.5	**25.2**	69.9	70.1	-1.0	60.6	2.66	3	700	2	3	**3**	8
CP7220	57.5	**11.4**	**27.8**	73.1	69.0	-1.4	59.6	3.37	3	740	3	2	4	7
Crescent AX	57.7	10.0	**27.9**	53.3	**71.2**	-0.7	59.4	5.87	**5**	940	4	**5**	**3**	**2**
Fortify SF	56.0	10.6	**23.3**	54.8	**71.6**	-1.1	59.6	3.95	3	930	3	3	**3**	5
Guardian	58.6	10.7	**26.0**	62.2	69.7	-0.8	**62.5**	5.31	**5**	**950**	4	**5**	**1**	**1**
Kivari AX	55.5	10.0	**25.7**	48.1	70.5	-1.1	58.8	5.50	**5**	870	**5**	3	5	**3**
KS Territory	54.8	**11.2**	**24.7**	68.3	69.0	-1.0	59.2	4.44	2	765	3	2	5	7
Langin	55.3	9.5	**25.2**	51.7	69.8	-0.6	59.7	**6.56**	**5**	890	3	4	5	**2**
LCS Atomic AX	56.8	10.5	**26.2**	52.4	70.3	-1.0	58.5	4.20	3	940	4	3	**3**	5
LCS Radar	56.3	**11.5**	**23.6**	47.9	70.0	-1.2	59.6	3.58	3	**950**	3	3	4	5
LCS Steel AX	55.9	10.5	**23.7**	67.4	68.6	-0.8	61.4	5.01	**5**	835	2	3	4	4
LCS White	57.8	10.5	**30.9**	53.9	70.1	**0.1**	**62.6**	4.44	3	880	3	3	**2**	4
Monarch	57.3	10.2	**26.7**	67.8	69.2	-1.1	59.9	5.28	4	855	4	3	**3**	4
NHH19668	58.5	**11.3**	**26.7**	65.6	70.9	-0.8	58.6	3.01	2	825	**5**	2	**1**	7
Sheridan	57.9	10.0	**24.8**	62.9	69.8	-1.0	60.9	4.93	4	855	4	3	**2**	4
Snowmass 2.0	58.0	9.7	**26.8**	68.9	69.8	**-0.4**	**62.6**	**8.58**	**6**	865	**5**	4	**2**	**1**
Steamboat	**58.7**	9.7	**27.1**	57.2	70.7	**-0.2**	59.6	4.27	4	835	3	3	**1**	4
Telluride	57.5	9.9	**24.8**	61.1	70.3	-1.2	60.8	5.47	**5**	850	4	4	**3**	**3**
Valley	56.6	9.8	**25.3**	65.6	68.1	-0.7	60.4	**6.83**	**5**	840	3	3	4	**2**
Whistler	56.6	10.4	**25.1**	66.8	68.3	-1.0	**63.7**	5.23	**5**	**975**	3	4	**3**	**1**
Windom SF	**60.0**	**11.5**	**26.3**	75.0	69.7	-1.0	**66.5**	5.41	**5**	**970**	4	4	**1**	**1**
Average	57.2	10.4	25.4	62.1	69.9	-0.9	60.3	4.84	3.8	865	3.4	3.1		
Minimum	54.5	9.5	22.8	47.9	67.6	-1.4	56.6	2.66	2	675	1	1		
Maximum	60.5	11.5	30.9	75.0	73.1	0.1	66.5	8.58	6	1020	5	5		

Wheat Milling and Baking Quality Data - 2024 IVPT Burlington

* **Bold** indicates superior value, underlined indicates inferior value.

Entry	Test Weight	Grain Protein	SKCS Weight	SKCS Hardness	Flour Yield	Protein Recovery	Bake Absorption	Mixograph Mix Time	Mixograph Tolerance	Loaf Volume	Crumb Color	Crumb Grain	**Milling Score**	**Baking Score**
Amplify SF	54.7	13.2	**27.3**	49.1	71.1	-1.0	59.4	3.03	0	900	4	3	**3**	8
Breck	**56.5**	**14.7**	**28.0**	53.1	71.5	-1.2	63.7	3.01	1	1040	**5**	4	**1**	5
Byrd CL Plus	54.1	14.1	**28.2**	48.7	70.7	-1.3	64.3	3.28	3	1020	**5**	**5**	**3**	4
Canvas	**56.0**	13.0	**25.4**	56.8	**73.0**	**-0.6**	64.6	4.67	4	1080	4	4	**1**	**2**
CO20022RC	**56.9**	13.7	**26.8**	55.5	**73.1**	-1.1	64.6	3.68	3	1055	3	4	**1**	4
CO20SFD019R	**56.0**	13.9	**30.4**	44.3	**73.5**	-1.5	60.5	3.70	2	1080	4	4	**1**	5
CO20SFD020R	54.7	12.9	**25.2**	54.0	70.5	-1.1	58.7	3.04	0	960	2	2	**2**	8
CO21SF191RA	50.3	**15.8**	**26.4**	60.0	65.7	-2.2	60.7	1.98	0	775	2	2	7	9
CP7017AX	55.4	13.7	**28.0**	49.4	72.3	-1.8	59.7	2.71	2	755	1	1	**2**	9
CP7266AX	55.6	13.6	**26.5**	54.7	71.5	-1.6	61.5	3.24	1	925	4	3	**2**	7
Crescent AX	54.5	13.4	**29.7**	45.5	71.9	-1.3	**65.6**	4.43	4	1100	**6**	**5**	**3**	**1**
Guardian	54.4	14.3	**27.8**	55.3	69.6	-1.1	**65.6**	3.78	4	1080	4	**5**	**2**	**2**
Kivari AX	52.8	12.9	**27.3**	48.6	72.3	-1.3	60.6	3.48	1	1065	4	3	**3**	6
LCS Atomic AX	55.2	13.4	**26.9**	52.6	71.2	-1.3	62.5	3.23	2	955	3	2	**2**	6
LCS Radar	52.9	14.4	**25.1**	46.3	71.1	-1.1	63.5	4.26	4	1075	**5**	**5**	**3**	**2**
LCS Steel AX	53.2	**14.6**	**25.0**	57.5	68.8	-1.8	63.5	**4.81**	3	1010	3	3	4	4
Monarch	51.5	13.5	**24.0**	54.1	69.6	-1.1	64.8	**4.79**	3	1065	**5**	4	4	**2**
NHH17612	54.2	**14.6**	**24.2**	58.5	69.3	-1.4	64.6	3.94	2	950	4	3	**3**	5
Sheridan	53.5	13.0	**24.0**	55.8	70.5	**-0.9**	64.5	**4.97**	4	1070	4	4	**3**	**2**
Snowmass 2.0	53.5	13.6	**27.6**	58.7	70.8	-1.6	**66.9**	**4.99**	**5**	**1155**	**5**	**5**	4	**1**
SY Wolverine	55.2	13.7	**29.0**	53.9	70.5	**-0.7**	61.9	3.34	0	915	4	4	**1**	7
Telluride	52.6	13.3	**24.8**	46.6	70.8	-1.1	**66.5**	**5.44**	**5**	1075	4	4	4	**1**
Windom SF	55.7	14.0	**28.1**	54.3	70.6	-1.7	**65.6**	4.20	4	1055	**5**	4	**2**	**2**
Average	54.3	13.8	26.8	52.8	70.9	-1.3	63.2	3.83	2.5	1007	3.9	3.6		
Minimum	50.3	12.9	24.0	44.3	65.7	-2.2	58.7	1.98	0	755	1	1		
Maximum	56.9	15.8	30.4	60.0	73.5	-0.6	66.9	5.44	5	1155	6	5		

Wheat Milling and Baking Quality Data - 2024 IVPT Fort Collins

* **Bold** indicates superior value, underlined indicates inferior value.

Entry	Test Weight	Grain Protein	SKCS Weight	SKCS Hardness	Flour Yield	Protein Recovery	Bake Absorption	Mixograph Mix Time	Mixograph Tolerance	Loaf Volume	Crumb Color	Crumb Grain	**Milling Score**	**Baking Score**
Amplify SF	60.8	**14.3**	**28.1**	65.0	71.2	-2.0	61.1	2.42	1	935	3	2	4	7
Breck	**62.6**	13.4	**27.8**	72.6	**72.8**	-1.2	62.3	2.82	3	1005	4	3	**1**	5
Byrd CL Plus	61.0	13.7	**29.0**	66.8	71.0	-1.2	64.4	2.48	2	875	2	1	4	7
Canvas	62.2	13.3	**24.3**	73.4	**72.9**	-1.1	62.4	3.46	2	1025	4	4	**1**	5
CO20022RC	**63.0**	12.7	**27.5**	74.0	**73.5**	-1.1	62.5	2.70	3	920	4	2	**1**	5
CO20SFD019R	62.1	**14.3**	**30.6**	64.0	**73.8**	-1.7	62.4	2.68	1	970	3	3	**1**	6
CO20SFD020R	62.1	13.6	**26.9**	75.6	71.6	-1.5	61.3	2.26	0	855	3	2	**2**	9
CO21SF191RA	59.5	14.1	**28.0**	71.5	70.4	**-1.0**	61.4	1.98	0	740	1	1	5	9
CP7017AX	62.2	13.1	**28.6**	71.9	72.1	-1.2	62.3	2.63	2	725	1	1	**1**	9
CP7266AX	61.3	13.1	**29.2**	74.2	71.2	**-1.0**	64.2	2.91	3	965	**5**	4	**2**	4
Crescent AX	61.2	13.6	**31.2**	64.6	72.0	-1.4	65.0	3.43	4	1015	4	2	4	**3**
Guardian	61.4	**14.3**	**26.9**	71.5	70.5	-1.5	**65.8**	3.54	3	**1130**	4	3	**2**	**2**
Kivari AX	61.2	13.1	**29.8**	72.2	**73.0**	-1.3	64.4	3.19	3	1015	3	3	**2**	4
LCS Atomic AX	61.2	13.1	**29.8**	71.1	71.8	**-0.9**	63.5	3.18	2	925	3	3	**2**	5
LCS Radar	61.2	**14.3**	**26.2**	63.4	71.2	-1.3	63.4	2.77	2	**1070**	4	4	**3**	4
LCS Steel AX	61.7	**14.2**	**31.9**	70.2	70.7	-1.4	63.5	3.08	2	940	3	3	**2**	5
Monarch	61.6	12.7	**31.5**	71.0	70.7	-1.4	63.5	3.31	4	960	4	4	**3**	**3**
NHH17612	61.5	13.9	**26.3**	74.3	70.4	**-1.0**	**66.4**	3.76	3	1045	4	3	**3**	**3**
Sheridan	61.4	13.3	**24.8**	76.1	70.3	-1.9	64.2	3.46	3	1000	4	3	4	4
Snowmass 2.0	61.3	14.1	**31.6**	73.3	70.4	-1.5	**70.1**	**6.21**	**5**	**1100**	**5**	**5**	**3**	**1**
SY Wolverine	61.5	**14.7**	**30.1**	74.9	71.1	-1.8	62.3	2.98	1	965	2	2	**3**	7
Telluride	61.4	12.8	**28.3**	67.0	71.7	-1.1	64.4	**4.46**	4	980	4	4	**3**	**3**
Windom SF	**62.6**	13.1	**29.1**	75.2	70.9	-1.1	**66.2**	3.64	3	1015	3	4	**1**	**3**
Average	61.6	13.6	28.6	71.0	71.5	-1.3	63.8	3.19	2.4	964	3.3	2.9		
Minimum	59.5	12.7	24.3	63.4	70.3	-2.0	61.1	1.98	0	725	1	1		
Maximum	63.0	14.7	31.9	76.1	73.8	-0.9	70.1	6.21	5	1130	5	5		

Wheat Milling and Baking Quality Data - 2024 UVPT Lamar

* **Bold** indicates superior value, underlined indicates inferior value.

Entry	Test Weight	Grain Protein	SKCS Weight	SKCS Hardness	Flour Yield	Protein Recovery	Bake Absorption	Mixograph Mix Time	Mixograph Tolerance	Loaf Volume	Crumb Color	Crumb Grain	**Milling Score**	**Baking Score**
Amplify SF	59.2	10.6	**28.2**	61.9	70.5	**-0.2**	59.4	2.78	1	825	4	3	**2**	8
AP Sunbird	59.9	10.9	**31.5**	55.7	71.2	-0.6	**63.3**	4.73	4	**1000**	4	3	**1**	**2**
Avery	58.0	10.0	**26.7**	49.2	69.2	-0.9	59.2	4.02	4	925	4	**5**	5	4
Breck	**61.3**	10.3	**30.2**	63.2	70.9	-0.5	61.6	4.84	4	860	**5**	3	**1**	4
Byrd	58.7	10.2	**26.3**	50.7	70.8	-0.9	60.2	4.16	4	970	4	**5**	**3**	**3**
Byrd CL Plus	57.5	10.3	**25.8**	48.7	69.8	-0.7	59.3	3.97	3	840	2	3	5	6
Canvas	**60.5**	10.7	**26.1**	58.4	**72.5**	-1.0	61.5	4.07	4	885	4	4	**1**	4
CO18042RA	58.2	9.7	**27.7**	45.8	71.1	**-0.4**	58.6	**5.73**	**5**	860	3	4	4	4
CO19410R	59.3	10.6	**26.7**	59.2	70.2	-0.7	**63.3**	4.53	**5**	**995**	4	4	**2**	**1**
CO19D087R	57.1	9.5	**25.6**	52.8	70.1	-0.4	58.4	**5.84**	4	850	3	3	5	5
CO200037R	**60.5**	10.5	**25.1**	64.5	70.8	**-0.4**	62.2	5.36	4	950	1	4	**1**	**3**
CO20022RC	59.9	10.6	**27.2**	60.6	71.0	-0.5	62.4	5.34	4	970	4	4	**1**	**2**
CO20D108R	59.9	10.1	**26.3**	62.7	70.4	-0.9	58.4	**7.27**	**5**	880	4	**5**	**2**	**2**
CO20SFD019R	60.0	10.2	**31.7**	48.1	**72.0**	-0.6	59.2	4.61	3	920	4	**5**	**2**	4
CO20SFD020R	59.4	10.4	**27.0**	52.9	69.7	-0.9	58.3	3.86	2	960	3	2	**3**	6
CO21SF191RA	57.9	**11.1**	**26.2**	64.1	68.4	-0.7	59.3	2.74	1	765	2	2	4	9
CO21SF263RA	57.5	**11.5**	**26.2**	62.7	69.4	-1.1	58.3	3.11	1	820	3	2	5	8
CP7017AX	59.2	9.8	**24.1**	63.5	**72.1**	-0.5	57.4	2.90	2	720	2	2	**2**	9
CP7220	59.2	11.0	**32.6**	62.8	70.1	**-0.4**	60.7	3.38	2	850	4	4	**2**	6
Crescent AX	59.5	10.6	**31.4**	50.7	70.6	-1.2	59.2	4.09	4	960	**5**	4	4	**3**
Fortify SF	58.3	**11.0**	**25.8**	47.1	71.2	-0.8	60.4	3.36	2	**1025**	4	**5**	**3**	4
Guardian	**60.4**	**11.0**	**27.3**	63.2	70.6	-0.9	62.3	4.71	3	**1045**	4	4	**1**	**2**
Kivari AX	58.1	10.9	**27.4**	50.2	**71.5**	-0.7	62.5	4.06	3	**995**	4	3	**3**	**3**
Langin	57.2	10.7	**26.8**	48.0	69.9	-0.8	61.3	4.29	4	**1020**	4	4	5	**3**
LCS Julep	**61.4**	**11.4**	**29.1**	68.2	69.2	-0.6	62.2	4.30	3	965	**5**	4	**1**	**3**
Monarch	59.6	10.7	**28.4**	62.0	69.7	-0.9	62.3	5.55	3	950	**5**	**5**	**2**	**3**
Sheridan	59.0	11.0	**24.2**	57.4	70.1	-0.9	60.4	4.46	4	950	**5**	**5**	**2**	**3**
Snowmass 2.0	59.6	10.5	**31.0**	65.5	68.7	-1.4	**66.3**	**7.31**	**5**	940	**5**	**5**	5	**1**
Telluride	58.3	9.9	**27.2**	53.9	70.6	**-0.4**	62.6	3.98	3	900	3	4	**3**	4
Whistler	58.7	9.2	**29.0**	61.6	68.0	-0.5	61.2	5.07	**5**	920	3	4	4	**3**
Windom SF	**60.8**	9.9	**31.5**	69.3	68.6	**-0.3**	**64.4**	5.31	**5**	940	**5**	**5**	**3**	**1**
Average	59.2	10.5	27.8	57.6	70.3	-0.7	60.8	4.51	3.4	918	3.7	3.8		
Minimum	57.1	9.2	24.1	45.8	68.0	-1.4	57.4	2.74	1	720	1	2		
Maximum	61.4	11.5	32.6	69.3	72.5	-0.2	66.3	7.31	5	1045	5	5		

Wheat Milling and Baking Quality Data - 2024 UVPT Sheridan Lake

* **Bold** indicates superior value, underlined indicates inferior value.

Entry	Test Weight	Grain Protein	SKCS Weight	SKCS Hardness	Flour Yield	Protein Recovery	Bake Absorption	Mixograph Mix Time	Mixograph Tolerance	Loaf Volume	Crumb Color	Crumb Grain	**Milling Score**	**Baking Score**
Amplify SF	61.6	13.0	**30.1**	69.4	71.5	-1.3	60.5	3.19	1	990	4	3	**2**	7
AP Sunbird	61.6	**15.5**	**31.1**	69.2	**71.8**	-1.8	63.5	4.14	2	1110	3	3	**1**	5
Avery	60.3	12.1	**26.4**	70.7	69.8	**-0.3**	63.5	4.70	3	1035	**5**	3	4	4
Breck	**62.9**	13.4	**29.9**	72.5	70.9	-0.8	63.5	3.58	2	**1125**	4	3	**1**	4
Byrd	61.2	12.8	**28.9**	70.6	**71.7**	-0.8	64.5	**5.51**	3	**1130**	4	4	**1**	**2**
Byrd CL Plus	60.9	12.1	**30.0**	69.4	70.3	-1.0	61.4	3.63	2	1010	4	3	**2**	6
Canvas	62.0	12.5	**26.4**	74.0	**71.9**	-0.5	64.5	4.29	3	1045	4	4	**1**	4
CO18042RA	59.9	12.6	**28.1**	63.9	69.7	-0.9	65.5	**5.72**	**5**	1070	3	4	5	**2**
CO19410R	60.8	**13.6**	**28.8**	72.5	71.2	-0.7	**66.4**	5.13	3	**1130**	**5**	4	**1**	**2**
CO19D087R	60.5	12.5	**29.3**	71.0	70.7	-1.1	63.5	4.70	3	1020	4	**5**	**3**	4
CO200037R	61.2	12.8	**26.3**	74.3	70.8	-1.1	60.6	3.80	2	1040	2	4	**3**	6
CO20022RC	62.0	12.6	**25.7**	76.7	71.4	**-0.4**	64.5	4.65	3	1090	4	4	**1**	4
CO20D108R	61.2	11.5	**25.9**	76.4	70.2	-0.9	61.6	**6.01**	3	995	4	4	**3**	4
CO20SFD019R	60.4	13.1	**29.2**	58.0	**72.2**	**-0.2**	64.5	3.32	2	1100	4	2	**3**	5
CO20SFD020R	**62.1**	11.7	**27.7**	72.2	70.9	-0.6	58.4	3.54	1	1005	**5**	3	**1**	7
CO21SF191RA	60.9	12.5	**28.6**	74.2	70.2	-0.9	61.3	2.65	1	875	3	3	**2**	9
CO21SF263RA	59.5	13.1	**26.5**	76.3	70.2	-1.0	61.4	2.65	1	860	3	2	5	9
CP7017AX	61.9	12.5	**27.9**	73.5	**73.0**	-1.1	59.3	3.21	2	935	3	4	**1**	8
CP7220	60.7	12.9	**29.8**	72.4	68.9	**-0.4**	60.4	2.63	1	850	4	3	**3**	9
Crescent AX	60.8	13.3	**27.9**	70.6	70.4	-1.1	65.4	4.20	3	**1200**	**5**	3	**3**	**2**
Fortify SF	59.8	13.4	**26.5**	66.2	70.8	-0.7	64.5	3.40	1	995	4	3	4	6
Guardian	61.9	11.8	**27.3**	75.1	70.2	**-0.4**	63.3	4.74	4	1050	4	4	**2**	**3**
Kivari AX	61.5	11.9	**28.0**	71.9	**72.7**	-0.7	62.5	4.73	3	1085	4	**5**	**1**	**3**
Langin	60.0	13.4	**27.3**	66.9	69.4	-1.0	65.5	4.62	4	**1125**	4	4	4	**2**
LCS Julep	**62.2**	13.2	**30.1**	71.5	69.8	-0.8	63.4	3.62	2	1055	**5**	4	**1**	5
Monarch	61.0	12.5	**30.5**	72.6	68.5	-1.1	64.4	4.66	3	1020	4	4	4	4
Sheridan	61.6	13.4	**27.9**	74.3	68.9	-1.6	65.5	5.00	4	1045	**5**	4	4	**2**
Snowmass 2.0	61.1	12.5	**28.5**	77.0	69.0	-0.5	**66.5**	**5.30**	4	1055	**5**	4	**3**	**2**
Telluride	61.3	12.3	**29.2**	66.3	69.9	-0.9	**65.7**	5.23	4	1065	**5**	4	**3**	**2**
Whistler	61.7	11.5	**30.0**	69.4	70.2	**-0.3**	63.6	**5.40**	**5**	1070	**5**	4	**2**	**2**
Windom SF	**62.5**	12.8	**29.7**	76.8	67.9	-0.8	**66.4**	5.16	4	1060	**5**	4	**3**	**2**
Average	61.2	12.7	28.4	71.5	70.5	-0.8	63.4	4.29	2.7	1040	4.1	3.6		
Minimum	59.5	11.5	25.7	58.0	67.9	-1.8	58.4	2.63	1	850	2	2		
Maximum	62.9	15.5	31.1	77.0	73.0	-0.2	66.5	6.01	5	1200	5	5		

Colorado Wheat Update

Brad Erker, Executive Director

Colorado Wheat is a strategic alliance that houses three distinct but cooperating organizations working together to serve the state's wheat growers. The **Colorado Wheat Administrative Committee** (CWAC) collects an assessment of two cents per bushel at first point of sale, and invests those funds in research, education, and promotional activities. Board members serve on the boards of US Wheat Associates, Wheat Marketing Center, and Plains Grains Inc. The **Colorado Association of Wheat Growers** (CAWG) is funded by voluntary membership fees and sponsorships. CAWG lobbies at the state and national level on policies that affect wheat, and board members serve on the Board of the National Association of Wheat Growers. CAWG does not utilize assessment funds for lobbying. The **Colorado Wheat Research Foundation** takes ownership of wheat varieties and traits developed at CSU and markets them in Colorado and regionally under the PlainsGold brand.

Colorado is the only wheat state that runs these three types of organizations in tandem as much as we do. CWAC and CAWG meetings are held jointly four times per year. The CWRF Board is composed of four members from CWAC, three members from CAWG, and two members from the Colorado Seed Growers Association. This cohesiveness is reflected in the new Colorado Wheat logos which all have a similar style, and in the new website, still at www.coloradowheat.org.

CWAC
COLORADO WHEAT ADMINISTRATIVE COMMITTEE

CAWG
COLORADO ASSOCIATION OF WHEAT GROWERS

CWRF
COLORADO WHEAT RESEARCH FOUNDATION

Colorado wheat producers planted 2.10 million acres for harvest in 2025, unchanged from 2024. **Langin** returned to being the top-planted variety with 12.9% of the acreage (NASS Winter Wheat Seedings by Variety Survey, 2025 Crop), after being the most-planted variety from 2020 through 2023. **Byrd** moved up from third place to second place, accounting for 10.7% of the acreage. **Avery** was third at 7.9%. **Amplify SF,** which was the top-planted variety in 2024, came in at fourth place with 6.7% of the acreage. Of varieties reported by name, 83% of the acreage was planted to varieties supported by the 2-cent/bushel wheat assessment (those released by CSU and marketed by PlainsGold). Colorado producers also reported that 53% percent of their seed planted was Certified wheat seed, and that 23% of their seed planted was treated with fungicide or insecticide.

As of this writing in May of 2025, **CWRF** is in negotiations with BioCeres and Albaugh to manage a new drought tolerance trait called HB4®. HB4® is a drought tolerance trait, sourced from a sunflower gene, and brought to market by BioCeres, an Argentinian company. This trait has been put into both soybeans and wheat. The trait modulates the expression of several other genes to provide drought tolerance, as well as providing a new tool for weed control in the form of tolerance to glufosinate herbicide (Liberty®).

In June 2022, the Food and Drug Administration approved the HB4® trait for food and feed consumption in the U.S. In August 2024, the United States Department of Agriculture approved

the HB4® trait for cultivation in the U.S. This marks the first time in history that a GM (genetically modified) trait has been deregulated for wheat. However, deregulation does not equal industry commercialization. Several steps must still be taken before US wheat growers will grow GMO wheat. One of the most important of these steps is acceptance by major wheat export markets. The US Wheat Associates/National Association of Wheat Growers "Wheat Industry Principles for Biotechnology Commercialization" state that "regulatory approvals for food and feed use must be secured in major wheat export markets that will be affected where a functioning regulatory system exists. Major export markets are defined as those which represent at least five percent of export volumes." There are seven countries currently on this list: Mexico, Philippines, Japan, China, South Korea, Nigeria, and Taiwan. CWRF is working to put a trait management system in place should these approvals occur. It will likely be five or more years before growers could grow this wheat commercially.

For more information on any of the work being done by Colorado Wheat, stay in touch with us:

Phone: (970) 449-6994

Email: info@coloradowheat.org

Websites: **www.coloradowheat.org** | **www.plainsgold.com** | **www.coaxium.com**

Social media

@coloradowheat
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Facebook.com/coloradowheat
Facebook.com/PlainsGold

Wheat Stem Sawfly in Colorado – Frequently Asked Questions

Punya Nachappa and Adam Osterholzer

Q: What type of insect is the wheat stem sawfly?
A: Despite their name, wheat stem sawflies (WSS) are wasps, not flies. They belong to the insect order *Hymenoptera*, along with ants, bees, and other wasps. Females possess a saw-like ovipositor used to cut into wheat stems to lay eggs, whereas males do not.

Q: How do I know if I have wheat stem sawfly in my field, what do they look like?
A: In early to mid-May, look for small (7–12 mm), yellow and black wasps on wheat along field edges. Adults typically face downward on stems. In mid to late June, cut stems open to check for: white, S-shaped larvae, sawdust-like "frass" inside stems.

Photo credit: K. Hansen


Photo credit: Bugwood.wiki

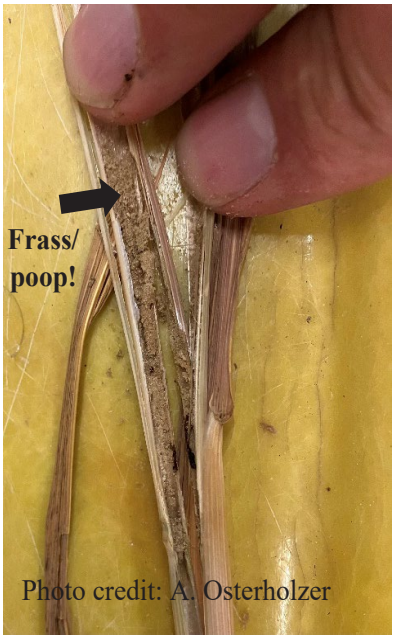
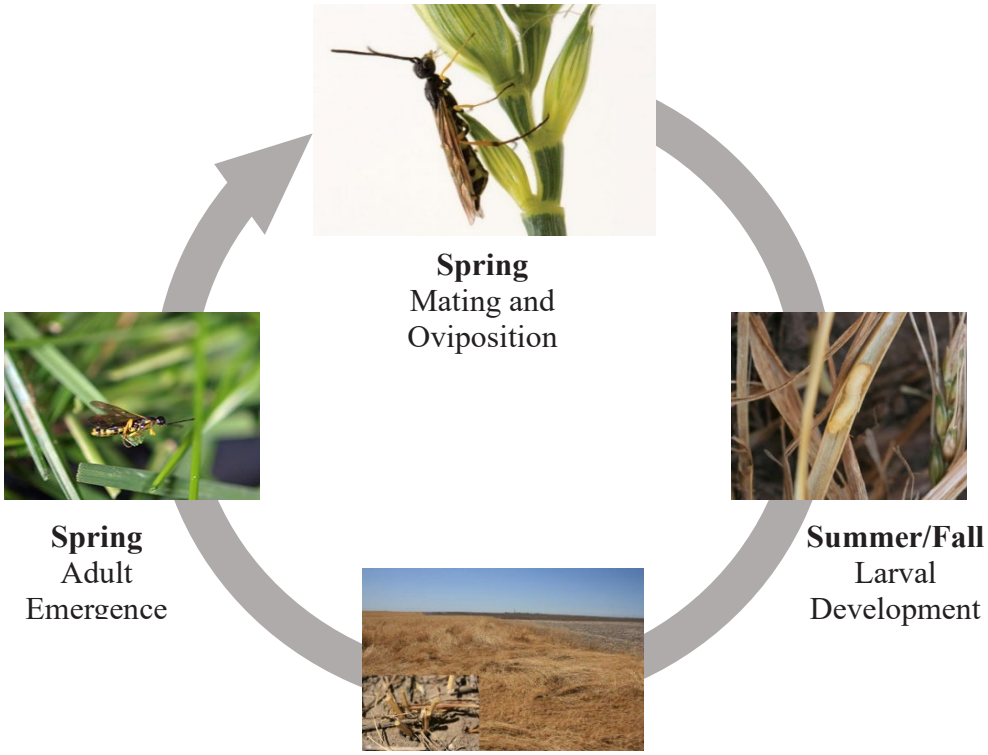


Photo credit: A. Osterholzer

Q: What does wheat stem sawfly damage look like?
A: Larvae feed inside stems, reducing nutrient flow and yield. Once mature, larvae cut the stem internally near the base, weakening it and causing it to fall (lodging), particularly during storms. Unlike stems lodged from other causes, sawfly-cut stems are no longer connected to the plant.

Q: Do we find wheat stem sawfly in all wheat-producing counties?
A: Since 2020, WSS has been identified in all wheat-producing counties in eastern Colorado. Most severe cases are in northern Colorado, and it was also found in Boulder County in 2023.

Q: Where are the wheat stem sawflies coming from?
A: Native to Colorado, WSS was first discovered in 1872 on wild grasses. It adapted to cultivated wheat with the expansion of agriculture as European settlers began large-scale cultivation of cereal crops. It has long been a threat to spring wheat production in the northern plains and has also become a significant pest of winter wheat.



Life cycle of wheat stem sawfly. Photo credits: Bugwood.wiki, Kelsey Dawson

Q: What is the life cycle of the wheat stem sawfly?
A:

- **Spring:** Adults emerge and lay eggs in wheat stems.
- **Summer/Fall:** Larvae develop inside stems.
- **Fall/Winter:** Larvae cut stems, form frass-filled chambers, and overwinter.

Q: How do weather patterns impact sawfly movement, and would severe cold temperatures kill off larvae?
A: Dry weather favors wheat stem sawflies. Excessively wet conditions are detrimental to both sawfly and parasitic wasp populations, as seen in 2023. Severe cold, as seen during the winter storm of 2020, typically does not affect wheat stem sawfly populations, as they are known to tolerate much colder temperatures in Canada.

Q: What is the estimated crop loss due to wheat stem sawfly in Colorado?
A: On average, from 2019 to 2022, the total economic impact of yield losses due to wheat stem sawfly was $124.3 million, averaging $31.1 million per year.

Year	Estimated losses in USD
2019	$23,900,000
2020	$21,100,000
2021	$37,800,000
2022	$41,500,000

Q: Why are we starting to have wheat stem sawfly problems now?
A: There is no good answer, but it is likely due to some combination of changes, including:

- Increased WSS preference for wheat.
- Reduced tillage practices.
- Changing climate conditions.

Q: How fast can wheat stem sawflies spread?
A: From 2012 to 2020, WSS spread from the New Raymer area to all eastern Colorado wheat counties and was mainly limited to north of I-70. However, we have been observing heavy infestations moving south of I-70 and towards the southern parts of the state. We have also observed eastward movement into a couple of counties in Kansas.

Q: Can we predict/react to wheat stem sawfly infestations ahead of time?
A: Yes. If over 10–15% of stems were cut by WSS the previous year, avoid planting wheat nearby or use resistant varieties.

Q: What are the hosts of wheat stem sawfly?
A**:** WSS primarily attacks wheat, triticale, barley, rye (not oats or flax) and many native and non-native grasses, including bromegrasses and wheatgrasses.

Q: What rotation crops can reduce the level of wheat stem sawfly infestation?
A: Crops like black-eyed peas, corn, millet, milo, sorghum, and sunflower are not affected by WSS and are good options. Do not include wheat, barley or triticale in cover crops or forage plantings. Incorporate spring or winter oats if a small grain is desired for cover crop or forage blends. Oats are a natural attractant and trap crop for WSS, killing nearly 100% of larvae arising from eggs laid within its stem. Avoid planting wheat next to previous-year wheat stubble.

Q: How long do I have to stay out of wheat to reduce the problem, so I can go back to wheat with minimal loss of yield?
A: Wheat can follow WSS-infested fields the next season, but the risk remains due to migration from nearby fields and grasses.

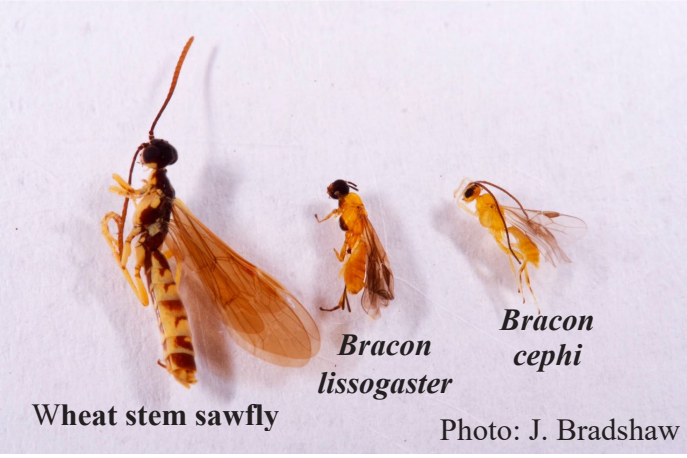
Q: How effective is tillage in controlling the wheat stem sawfly?
A: Not especially. Tillage may expose larvae but also kills the parasitoid wasps (natural enemies). Best for fields with low to moderate infestations.

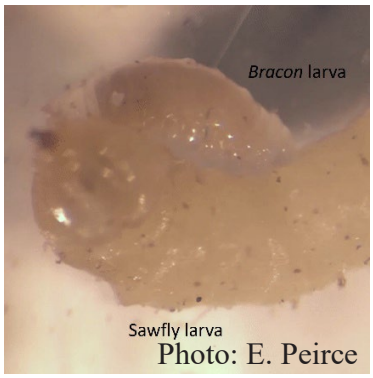
Q: Are there wheat varieties that are resistant to wheat stem sawfly?
A: Yes, there are sawfly-resistant varieties that have a trait called “solid stem”. In these plants, the center of the stems is filled entirely with tissue, making it difficult for eggs to be laid inside it and impeding larval development, thus reducing larval survival. CSU has released several “semi-solid” lines. These lines are optimized for WSS resistance while reducing yield penalties. Breeding for WSS resistance remains a high priority for CSU.

Q: What is known about the consistency of expression of stem solidness, and the degree of resistance conferred by the new semi-solid varieties?
A: Lower light intensity from increased cloud cover or lower elevation may result in reduced expression of solidness. Resistant varieties outperform susceptible ones under WSS pressure.

Q: Is there a yield drag associated with the new semi-solid varieties?
A: Yes—about 4.5% lower yield in non-infested conditions. However, semi-solid varieties will outyield susceptible varieties if both are infested with sawflies.

Q: Does the wheat stem sawfly have any natural enemies?
A: Yes. Two parasitic wasps, *Bracon cephi* and *Bracon lissogaster*, attack WSS larvae in stems. *B. cephi* is more common of the two species. The parasitoid larva eats the sawfly larva, and the adult parasitoids consume honeydew, pollen, or nectar.





Q: How important are these parasitic wasps in Colorado?
A: Only a few have been found in wheat fields so far. They're more prevalent in native grasses and regions with a longer WSS history. We are conducting experimental releases of parasitoids from Nebraska in New Raymer, Orchard, and Byers Colorado with the hope that they will establish and build populations that can keep the sawfly population low.

Q. Can the Nebraska parasitoids kill Colorado sawflies?
A**.** Yes, we experimented and found that Nebraska and North Dakota/Montana parasitoids can kill Colorado sawflies.

Q: Are there practices that will encourage the parasitic wasps to attack wheat stem sawfly?
A: Yes.

- Harvest with a stripper header to maximize standing stubble height to enhance parasitoid wasp larvae survival during harvest and winter.
- Leave at least 75% of the wheat and barley residue on the soil surface.
- Avoid swathing and tillage where possible.
- Avoid using inversion tillage within the rotation (i.e. moldboard plow, disk, chisel) until after parasitoids have emerged, usually around the beginning of July in Colorado. Do not burn, bale, or graze wheat or barley residue.
- Avoid the use of pyrethroids, carbamates, or organophosphate insecticides, as they are ineffective against sawflies but can kill parasitoids.
- Include nectar-producing plants like buckwheat, black-eyed peas, or sunflowers that provide food for the adult parasitoids.
- Incorporate perennial grasses into conservation plantings (CSP, CRP) to provide late-season hosts and parasitoid disturbance refuges. Suitable grasses include intermediate and western wheatgrasses.

Q: How can I control existing wheat stem sawfly infestations in my wheat?
A: Once your wheat is infested, little can be done to eradicate the sawflies. No effective chemical controls are available at this time. Stem cutting can be reduced by swathing, and stripper headers are better at picking up cut stems than traditional headers. Planting resistant varieties of wheat and using proper crop rotations can further mitigate losses.

Q: Can wheat stem sawflies be controlled with insecticides?
A: Not currently. We are evaluating the efficacy of commercially available entomopathogenic fungi *Beauveria bassiana*, *Metarhizium anisopliae* and *Isaria fumosorosea* against sawflies.

Q: Will swathing my wheat reduce losses to wheat stem sawflies?
A: Yes, if done before stem cutting. Swathing field edges can reduce costs and preserve parasitoids.

Q: What is the best way to recover cut stems during harvest?
A: Combines equipped with stripper headers are most efficient in picking up cut stems at harvest.

Q: Can the wheat stem sawfly be eradicated?
A: No. WSS is native and widespread in both cultivated and wild grasses. Complete eradication is not currently possible.

Q: How do I prevent wheat stem sawfly infestations in my wheat?
A: The following are good practices:

- Use semi-solid wheat varieties.
- Avoid continuous wheat and planting next to stubble.
- Plant wheat in larger blocks to reduce edge infestation.

Q: What research is being done at CSU in response to the wheat stem sawfly outbreak?
A: CSU Wheat entomology program research is focused on

- Screening WSS-resistant wheat lines for the CSU wheat breeding program.
- Developing a degree-day model.
- Screening for novel sources of resistance in wild wheat species.
- Improving biological controls, including releasing parasitoid wasps and testing the efficacy of entomopathogenic fungi.
- Continued surveys to monitor WSS spread.

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Additional Resources:
https://wiki.bugwood.org/HPIPM:Wheat_Stem_Sawfly https://extension.colostate.edu/topic-areas/insects/wheat-stem-sawfly-a-new-pest-of-colorado-wheat-5-612/
https://www.ag.ndsu.edu/publications/landing-pages/crops/wheat-stem-sawfly-e-1479

Further information available at www.csuwheatentomology.com

Colorado Wheat Stem Sawfly Survey

Adam Osterholzer and Punya Nachappa

Background

The wheat stem sawfly (*Cephus cinctus*) has become an increasingly significant pest in Eastern Colorado wheat production since its initial detection in 2010 near New Raymer. Adult sawflies emerge from wheat stubble in the spring, coinciding with the jointing stage of wheat development. Females lay eggs inside wheat stems over a 4–6-week flight. Once the eggs hatch, the larvae feed on the internal pith, compromising plant integrity. As the plant matures, larvae move toward the crown, construct a pupation chamber, and sever the stem, causing lodging before harvest.

Survey Overview

To assess the geographic spread and severity of WSS infestations, a statewide survey has been conducted annually since 2013. Survey sites are selected based on wheat acreage per county, proximity to the previous year's wheat stubble, and minimum distance of 10 miles from other survey sites. At each site, 100 wheat tillers are dissected to determine the presence of WSS larvae. Infestation levels are classified as follows:

- **Low**: <10% of tillers infested
- **Medium**: 11%–50% of tillers infested
- **High**: >50% of tillers infested

Infestation Trends

From 2013 through 2024, survey data indicated a steady increase in the proportion of infested sites, including a notable rise in locations with medium and high infestation levels. In 2023, there was a significant reduction in sawfly infestation due to the above-average precipitation levels, which may have negatively affected WSS survival or emergence. In 2024, sawfly infestations jumped back with an increased severity and spread southward of I-70.

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
0%	56	50	32	81	42	46	41	33	44	34	17	16
<10%	20	30	48	11	36	26	29	41	33	15	25	17
11-50%	13	15	16	4	13	12	22	20	20	24	19	19
>50%	5	5	3	3	5	12	14	11	3	21	4	17
Total Sites	94	100	99	99	96	96	106	105	100	94	65	69

Table 1: Number of wheat fields in each WSS infestation category from 2013 to 2024.
Additional results from previous years can be found at www.csuwheatentomology.com.

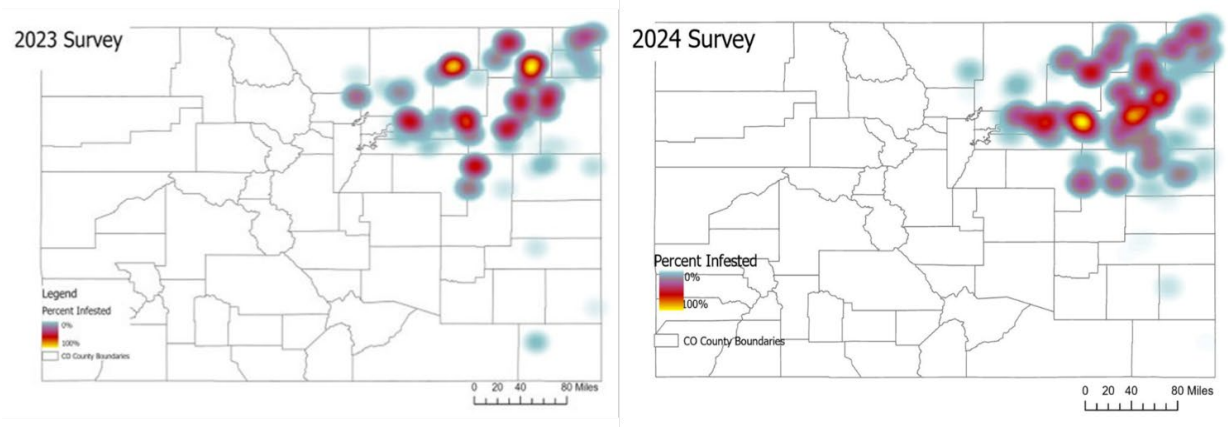

Figure 1: State-wide WSS infestation in 2023 and 2024.

Acknowledgements
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Increasing Incidence and Severity of *Triticum mosaic virus* Disease

Lukas Migliano and Robyn Roberts

Figure 1. Wheat plants from Colorado fields infected with viruses (TriMV and WSMV).

Viruses cause the highest yield losses due to disease in Colorado, with *Triticum mosaic virus* (TriMV) and *Wheat streak mosaic virus* (WSMV) being the most common and economically important. Infected plants typically appear with chlorotic streaks, mosaic patterns, yellowing, stunted growth, and early maturity **(Figure 1**). Co-infection with both viruses often results in more severe symptoms and greater yield losses. Importantly, there is effective resistance against WSMV in several PlainsGold® varieties, and TriMV resistance will be available for fall planting. Resistance against the vector that spreads these viruses, the wheat curl mite (WCM), also helps reduce the incidence and severity of these diseases.

Virus Incidence

While WSMV has historically been the dominant virus in Colorado, TriMV is strikingly on the rise. Since 2021, our lab has observed a noticeable increase in TriMV, especially as a single infection, along with a decline in WSMV (**Table 1**).

Table 1. TriMV incidence is increasing in field-collected, virus symptomatic samples sent to the Roberts' lab for diagnostics.

Year	Total # Samples	WSMV	TriMV	WSMV + TriMV	% of samples with TriMV only
2021	32	4	1	3	3%
2022	6	0	0	5	0%
2023	17	0	16	1	94%
2024	29	0	25	4	86%

Virus Transmission

Both TriMV and WSMV are transmitted by the wheat curl mite, which acquires viruses during feeding on infected plants. New plants are infected when mites carrying the viruses subsequently feed on healthy plants. Environmental conditions influence mite behavior, and therefore virus transmission. Hot, dry weather encourages mite movement as they search for water, increasing the chances of spreading viruses. In contrast, cooler temperatures and rainfall tend to reduce mite activity and disease spread. Additionally, strong winds can carry mites long distances across fields.

Virus Management and Prevention

There is no single solution to managing and preventing virus diseases; rather, an integrated approach must be taken. First, breaking the "green bridge," a continuous presence of live wheat, corn, or grassy weeds between seasons, is essential. The green bridge allows mites to survive over winter and carry viruses into the next crop. Therefore, removing volunteer wheat, corn, and weeds between harvest and planting is essential (**Figure 2**). Planting wheat varieties with resistance to WSMV and WCM also reduces disease. TriMV resistance will be available in PlainsGold® starting in fall 2025.

Figure 2. An example of poorly managed volunteer wheat in a Colorado field that contributed to high virus incidence and severity in surrounding fields.

Exploring the Use of Cowpea in Wheat Rotations

Jessica Davis, Marissa Spear, Kat Caswell, and Joel Schneekloth

Finding alternative crops for dryland wheat cropping systems has been a long-term objective of cropping system research in eastern Colorado. Producers in this region have approached this issue by switching from a wheat-fallow rotation to a wheat-corn-fallow rotation over the past 30 years. Fallowing costs have increased, and producers are looking for economically viable crops to replace fallow. Legumes have the potential to reduce water and fertilizer use, which has implications for both the water and carbon footprint of crops grown in rotations which incorporate them. Cowpea has shown potential as a fallow replacement crop in eastern Colorado with favorable growth under variable conditions and limited water use. This crop also fits well into current dryland production systems since it allows for planting of winter wheat shortly after harvest. Herbicide resistant weeds and difficult-to-control grass weeds present a challenge in wheat-corn rotations. As a summer annual broadleaf crop, cowpeas offer the opportunity to apply cultural control methods and rotate herbicide modes of action, different from those used in the typical wheat-corn-fallow system. Varying cultural controls and more diverse crop rotations are typically associated with greater weed control. However, long-term impacts need to be measured on the wheat crop, and the economic and environmental impacts within the wheat cropping system need to be evaluated.

The purpose of this study is to compare three dryland winter wheat rotations (wheat-corn-fallow, wheat-corn-millet, and wheat-corn-cowpea) in their effects on:

- Wheat yield and protein content
- Weed pressure
- Pre-plant soil water storage
- Pre-plant residual soil nitrogen
- Profitability

In 2024 (the first year of a 3-year study) at Akron, wheat yield following fallow was significantly higher than wheat yield following either millet or cowpea. Wheat yield following fallow was an average of 59 bu/ac, with 26 bu/ac and 30 bu/ac following millet and cowpea, respectively. However, there was no difference in wheat protein concentrations which were around 15%.

Weed density was much higher in the millet plots (27.7 plants/sq meter) than in any other crop (0.7 – 4.8 plants/sq meter). Summer annual weeds included puncture vine, barnyard grass, sandbur, pigweed, windmill grass, and stinkgrass. The main perennial weed was purple three awn.

Soil moisture before planting wheat was significantly affected by the preceding crop (Figure 1 top). Where millet preceded wheat, there was less soil moisture present compared to cowpea preceding wheat (-5.2%) and compared to fallow preceding wheat (-5.8%). At wheat harvest, the preceding crop significantly affected remaining soil moisture levels (Figure 1 bottom). Where millet preceded wheat, there was less soil moisture present compared to cowpea preceding wheat (-2.1%).These differences in soil moisture may play a role in the wheat yield reductions following millet or cowpea.

There was no significant difference in the pre-plant Residual Soil Nitrogen (0-24 inches), in either nitrate or ammonium, for wheat following the different crops.

This research will continue through 2026.

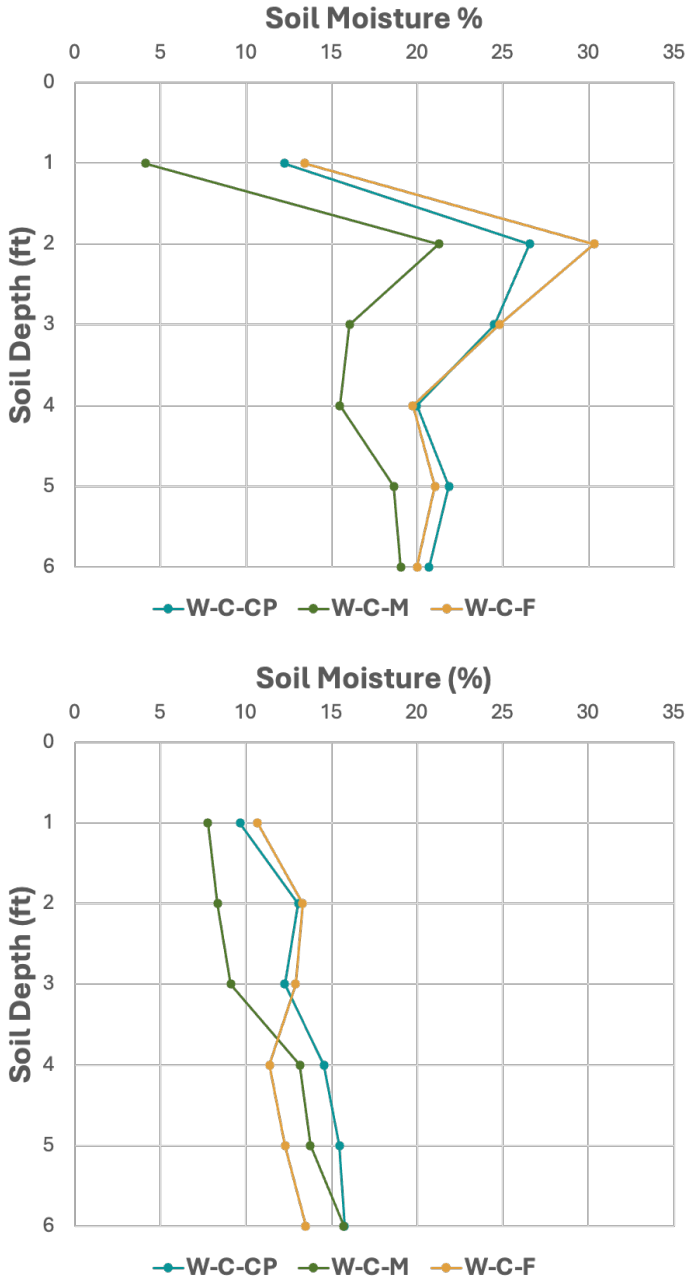

Figure 1. Pre-plant soil moisture before planting wheat in 2023 (top) and soil moisture at harvest in 2024 (bottom) as affected by three rotations: W-C-CP (wheat-corn-cowpea), W-C-M (wheat-corn-millet), and W-C-F (wheat-corn-fallow).

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