

Wheat Quality Evaluations from the 2014 CSU Dryland and Irrigated Variety Trials

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Introduction

End-use quality maintenance and improvement is an important objective of virtually all wheat breeding programs. Grain buying and end-use industries have become increasingly sophisticated in both domestic and export markets and, while wheat producers are seldom rewarded for improved functional quality, technological advancements promise to increase the ability of the trade to identify and source good quality and discount poor quality.

Breeding for wheat end-use quality is relatively complex in comparison to many common 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 involved in expression of each. 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 improved quality but is often associated with lower yields (and vice versa). 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 Colorado variety trials is to fully characterize the quality of public and private trial entries that are currently or have the potential to be marketed in Colorado. We hope that these data and ratings will be included among the criteria by which wheat producers make their variety selection decisions. 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 2014, grain samples were collected from six dryland (UVPT) variety trial locations (Akron, Julesburg, Orchard, Roggen, Walsh, Yuma) and two irrigated (IVPT) variety trial locations (Fort Collins, Haxtun). Preliminary small-scale quality analyses were carried out to determine sample suitability for full-scale analyses, with criteria including grain protein not too far below or above 12% grain protein content, sound grain free of visual defects, and good discrimination among samples at a given location for experimental dough mixing properties. In this process of sample selection, three of the dryland locations (Orchard Roggen, Yuma) were excluded from analyses beyond protein content with the primary issue being protein values well below the level conducive for meaningful dough mixing and baking quality evaluations.

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 ash content: obtained by prediction using whole-grain near-infrared reflectance spectroscopy (NIRs) with a Foss NIRSystems 6500. Both grain protein and ash are 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. Grain ash represents the remaining weight of a grain sample following incineration in a high-temperature oven. Millers prefer low wheat ash (values < 1.6%), as this provides low-ash flour after milling and products with improved color properties.

- Single kernel characterization system (SKCS): the Perten SKCS 4100 provides data on kernel weight and hardness of a grain sample. From 100-300 kernels are analyzed to provide an average and a measure of variability (standard deviation, STD) for each trait. Millers prefer a uniform sample with heavier (>30 grams/1000 kernels) kernels for improved milling performance. 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 percentage with low flour ash 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 (between 3 and 6 minutes) and good tolerance to breakdown of the dough with overmixing (subjective score >3). Some varieties with exceptionally long mixing times (i.e., Snowmass, Thunder CL) may not compare favorably with other varieties in conventional evaluations but have unique characteristics that merit handling in an identity-preserved program such as with the CWRP ConAgra 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. In general, bakers prefer higher water absorption (> 62%), high loaf volume (> 850 cubic centimeters), and a higher crumb grain score and crumb grain color (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 may be used as a means to differentiate and characterize quality of different samples. The development of a composite score also has the advantage of "smoothing" out differences in environmental conditions from year to year and utilizing all of the data generated on the samples from year to year.

Composite scores are generated through a two-step process. First, each trait is ranked from high to low (or "good" to "bad") at individual locations and a score from 1=good to 9=bad is assigned to each variety for each 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%, kernel weight 20%, grain hardness 10%, flour yield 20%, grain ash content 10% (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 - 2014 Akron

 * Value in **bold** indicates superior value, value in *italics* indicates inferior value.

Entry	Test Weight	Grain Protein	SKCS Weight	SKCS Hardness	Flour Yield	Grain Ash	Bake Absorption	Mixograph Mix Time	Mixograph Tolerance	Loaf Volume	Crumb Color	Crumb Grain	Milling Score	Baking Score
1863	57.9	14.0	27.9	64.0	73.4	1.31	63.6	4.03	3	1045	4	3	4	3
Above	56.7	13.9	29.1	65.0	72.6	1.35	<i>61.3</i>	3.24	2	935	3	3	5	6
Akron	56.9	14.3	28.3	69.6	<i>70.3</i>	<i>1.46</i>	62.7	4.08	3	1120	4	4	6	2
Antero	58.4	13.7	32.2	65.0	72.8	1.38	62.8	4.81	3	965	4	3	3	4
Bearpaw	58.4	14.6	<i>26.1</i>	77.2	72.9	<i>1.54</i>	63.9	3.64	2	970	4	3	6	4
Bill Brown	57.7	14.6	<i>27.3</i>	71.7	72.2	1.39	64.5	4.33	3	1010	3	4	5	2
Bond CL	<i>56.4</i>	<i>13.4</i>	<i>27.4</i>	64.0	<i>71.2</i>	1.38	<i>61.4</i>	3.67	4	1020	5	3	7	3
Brawl CL Plus	58.7	14.7	30.6	64.7	73.4	1.36	62.8	3.39	2	1165	4	4	2	3
Byrd	57.4	14.3	28.7	67.5	74.3	1.43	62.7	<i>6.10</i>	4	1220	4	4	3	3
Clara CL	59.1	14.3	28.8	72.5	72.3	1.45	63.7	4.08	3	1105	5	5	4	1
CO09W009	58.9	14.2	28.4	63.6	72.4	1.37	63.6	4.89	4	1070	4	4	4	2
CO09W040-	57.9	<i>13.0</i>	31.3	56.2	74.0	1.34	59.6	2.81	<i>1</i>	875	3	3	4	9
CO11D174	57.4	13.8	29.3	67.0	73.7	1.36	63.3	5.64	5	1140	5	4	4	2
CO11D346	56.8	14.0	31.4	63.9	73.5	1.34	63.7	3.71	3	920	3	3	3	5
CO11D446	57.2	13.9	28.0	64.7	74.0	1.39	62.6	<i>7.79</i>	6	1145	5	4	4	3
Cowboy	58.0	14.1	29.6	67.1	73.4	1.36	64.4	3.84	3	925	2	2	3	4
CSU Blend13	57.3	14.2	28.3	68.7	72.0	1.39	63.7	4.18	3	1005	4	3	5	2
Denali	58.7	13.8	29.0	67.8	73.0	1.42	62.8	3.21	3	895	2	2	3	6
Freeman	<i>54.5</i>	15.2	<i>27.4</i>	<i>57.8</i>	<i>71.5</i>	1.39	65.3	4.63	4	1080	4	3	9	1
Gallagher	57.7	14.1	29.3	75.8	72.1	<i>1.46</i>	63.2	3.99	2	930	4	4	6	4
Hatcher	58.0	13.9	29.7	69.3	71.6	1.33	63.6	4.38	4	955	4	3	4	3
Iba	58.8	13.9	28.6	63.0	73.6	1.44	<i>60.8</i>	3.94	2	995	4	3	4	5
KanMark	58.4	14.2	27.2	70.2	74.2	1.36	63.7	4.11	3	1040	4	3	4	2
KS10HW78-1	59.1	14.1	33.6	65.9	75.0	1.36	<i>61.3</i>	2.74	<i>0</i>	865	4	3	1	9
LCH11-1064	<i>55.7</i>	14.4	29.5	64.7	71.9	1.38	62.2	3.00	2	870	3	3	6	7
LCS Mint	58.6	14.0	30.5	66.2	73.5	1.32	64.7	4.48	4	1135	5	4	2	1
LCS Pistol	56.8	14.7	<i>25.0</i>	<i>51.6</i>	<i>67.7</i>	1.45	62.6	3.03	<i>1</i>	955	3	3	9	7
Oakley CL	59.2	14.2	32.8	71.2	73.2	1.43	63.6	4.04	4	1000	4	3	2	2
Prairie Red	<i>56.2</i>	13.8	29.8	69.5	71.9	1.43	63.6	3.68	3	1050	4	4	6	3
Ripper	<i>56.4</i>	14.4	31.6	69.6	72.7	1.34	64.7	3.38	3	935	3	2	4	4
Robidoux	57.0	14.2	27.8	64.6	73.4	1.38	63.6	5.06	4	1120	5	5	4	1
Settler CL	58.2	13.9	31.6	70.9	72.1	1.44	62.9	5.05	4	1025	4	3	4	3
Snowmass	57.2	14.1	30.4	78.7	71.7	1.39	64.6	<i>7.54</i>	6	1130	5	5	5	2
Sunshine	58.4	13.9	34.9	62.1	73.0	1.34	62.8	5.06	5	1120	4	4	2	2
SY Monument	<i>56.4</i>	13.9	28.8	72.2	74.0	1.29	63.4	5.28	5	1090	5	4	5	2
SY Wolf	57.2	14.5	29.2	69.1	72.7	1.40	<i>60.7</i>	4.47	<i>1</i>	1000	3	3	4	6
T158	57.6	<i>13.4</i>	31.4	62.3	74.6	1.35	<i>61.7</i>	3.40	2	1055	4	3	3	5
TAM 111	57.4	14.7	28.4	65.6	<i>71.5</i>	1.33	64.6	3.94	3	945	2	3	5	4
TAM 112	58.4	14.3	30.3	74.6	<i>71.1</i>	<i>1.50</i>	63.7	4.19	4	1125	4	5	6	1
TAM 113	57.6	14.6	29.5	71.5	72.5	1.40	62.4	3.65	2	1025	4	4	4	4
Warhorse	57.7	15.8	26.7	86.2	<i>71.2</i>	<i>1.47</i>	65.8	3.71	3	1085	4	3	6	2
WB-Grainfield	57.4	13.9	30.1	67.9	73.9	1.37	<i>61.6</i>	3.25	<i>1</i>	1010	4	3	3	6
Winterhawk	58.9	14.4	33.3	68.9	73.9	1.39	62.8	3.44	2	1030	4	3	1	4
Yumar	58.4	13.9	29.2	68.5	71.9	1.36	63.7	4.41	4	1050	4	4	4	2
Average	57.7	14.2	29.5	67.7	72.7	1.39	63.1	4.21	3.1	1026	3.9	3.4		
Minimum	54.5	13.0	25.0	51.6	67.7	1.29	59.6	2.74	0	865	2	2		
Maximum	59.2	15.8	34.9	86.2	75.0	1.54	65.8	7.79	6	1220	5	5		

Wheat Milling and Baking Quality Data - 2014 Julesburg

 * Value in **bold** indicates superior value, value in *italics* indicates inferior value.

Entry	Test Weight	Grain Protein	SKCS Weight	SKCS Hardness	Flour Yield	Grain Ash	Bake Absorption	Mixograph Mix Time	Mixograph Tolerance	Loaf Volume	Crumb Color	Crumb Grain	Milling Score	Baking Score
1863	60.2	14.3	37.5	55.7	73.9	1.40	62.6	3.38	1	1015	3	3	4	5
Above	60.1	13.2	40.9	62.1	73.1	1.54	60.2	2.65	1	885	3	3	3	8
Akron	60.1	14.5	34.5	61.6	72.6	1.53	64.6	3.67	3	1105	4	4	5	2
Antero	60.4	12.4	38.8	54.0	74.9	1.49	59.5	3.43	1	925	3	3	5	7
Bearpaw	60.5	14.4	35.9	73.9	74.3	1.60	62.6	3.13	1	1045	4	4	6	5
Bill Brown	61.1	13.3	35.4	62.2	74.7	1.51	61.2	3.21	1	985	4	3	5	6
Bond CL	59.6	14.3	37.2	57.3	72.1	1.55	62.4	2.46	2	880	4	3	6	7
Brawl CL Plus	60.3	14.2	36.1	59.8	74.3	1.55	61.6	3.30	2	1050	5	5	4	4
Byrd	61.3	13.6	36.6	58.9	76.4	1.48	63.7	5.01	5	1145	4	4	3	2
Clara CL	60.8	15.5	37.0	64.2	72.3	1.68	66.5	3.48	3	1075	4	4	5	1
CO09W009	62.0	13.9	40.2	57.5	73.7	1.48	64.4	4.54	3	1120	4	4	2	2
CO09W040-	61.4	13.6	39.7	51.8	75.3	1.42	61.4	3.08	1	875	3	3	3	8
CO11D174	60.7	13.4	37.5	64.4	75.1	1.54	63.4	4.78	4	1090	5	5	3	2
CO11D346	60.4	13.3	42.7	53.8	74.8	1.49	61.4	3.34	1	930	2	2	3	7
CO11D446	60.7	13.6	34.4	65.1	75.3	1.50	64.4	6.52	5	1075	5	4	5	3
Cowboy	61.4	13.6	40.2	61.7	74.4	1.56	63.5	3.15	3	925	2	3	3	5
CSU Blend13	60.4	13.5	38.6	62.1	74.0	1.54	62.5	3.84	2	970	3	3	4	4
Denali	61.8	13.5	36.9	58.6	73.9	1.52	60.6	2.62	1	900	2	3	4	9
Freeman	58.9	15.2	35.7	51.4	73.4	1.50	65.2	4.27	4	940	3	3	7	3
Gallagher	61.2	13.0	42.7	70.0	74.0	1.54	63.4	3.47	2	935	3	4	4	4
Hatcher	60.4	14.6	38.5	58.8	72.7	1.47	64.5	4.60	3	1030	5	4	4	3
Iba	61.1	15.0	35.8	54.4	74.3	1.54	65.6	4.41	3	1075	4	4	5	2
KanMark	61.1	14.5	35.8	61.2	75.8	1.51	63.5	3.92	2	1065	3	3	3	3
KS10HW78-1	61.3	14.0	39.8	61.7	75.7	1.45	62.3	2.92	0	915	2	2	2	7
LCH11-1064	60.1	12.9	41.2	67.4	72.3	1.52	62.5	4.14	4	1090	6	5	5	1
LCS Mint	60.8	13.9	36.9	58.7	73.7	1.43	63.8	4.11	3	1070	4	4	4	2
LCS Pistol	60.0	14.4	31.9	52.2	71.1	1.52	63.3	3.27	2	1045	3	3	8	4
Oakley CL	61.3	15.8	39.9	67.6	74.6	1.54	65.4	3.35	1	990	3	3	3	4
Prairie Red	60.9	14.2	35.4	65.5	72.3	1.56	64.4	4.10	2	1040	3	4	6	3
Ripper	60.0	14.0	39.5	57.5	75.3	1.48	62.5	2.64	1	990	2	3	3	6
Robidoux	59.7	14.0	36.1	55.6	74.8	1.42	64.6	4.00	4	1075	4	3	5	2
Settler CL	60.6	13.5	38.9	60.2	74.1	1.58	63.5	4.40	3	1025	5	4	4	3
Snowmass	60.8	13.4	43.5	64.6	73.2	1.48	64.3	5.48	5	1075	5	5	3	2
Sunshine	60.6	13.5	39.8	53.2	73.8	1.50	63.6	5.22	5	1050	4	4	4	3
SY Monument	60.1	15.1	39.0	68.0	74.5	1.56	65.3	4.66	5	1070	4	5	4	1
SY Wolf	61.2	15.0	37.5	67.7	73.3	1.65	61.5	3.96	1	1000	3	3	5	5
T158	60.9	13.8	39.4	55.0	74.4	1.47	63.7	3.77	3	925	3	3	3	4
TAM 111	61.2	14.3	36.5	60.8	73.5	1.55	63.6	3.63	2	900	3	2	4	5
TAM 112	61.1	14.2	38.1	62.3	71.7	1.58	65.5	4.07	4	1160	4	4	5	1
TAM 113	61.0	13.9	35.5	64.8	73.5	1.51	63.5	3.49	2	1100	5	4	5	2
Warhorse	60.6	13.7	33.4	77.9	72.4	1.61	64.5	4.27	3	1130	4	5	8	1
WB-Grainfield	60.7	13.9	35.2	63.5	74.6	1.43	62.6	3.40	1	990	2	2	4	5
Winterhawk	61.4	14.3	42.3	55.9	75.0	1.55	64.6	3.26	3	965	3	3	2	4
Yumar	60.4	15.4	35.5	64.7	72.0	1.53	66.4	4.88	5	1080	4	3	6	1
Average	60.7	14.0	37.8	61.0	73.9	1.52	63.4	3.85	2.6	1016	3.6	3.5		
Minimum	58.9	12.4	31.9	51.4	71.1	1.40	59.5	2.46	0	875	2	2		
Maximum	62.0	15.8	43.5	77.9	76.4	1.68	66.5	6.52	5	1160	6	5		

Wheat Milling and Baking Quality Data - 2014 Walsh

 * Value in **bold** indicates superior value, value in *italics* indicates inferior value.

Entry	Test Weight	Grain Protein	SKCS Weight	SKCS Hardness	Flour Yield	Grain Ash	Bake Absorption	Mixograph Mix Time	Mixograph Tolerance	Loaf Volume	Crumb Color	Crumb Grain	Milling Score	Baking Score
1863	59.2	14.1	28.9	50.5	72.9	1.34	61.1	2.98	1	955	3	3	4	7
Above	59.2	13.2	30.5	64.1	72.3	1.60	59.8	2.51	1	910	4	4	6	8
Akron	58.3	14.9	29.2	54.6	70.9	1.51	62.5	3.64	1	1105	5	4	6	3
Antero	60.7	13.3	30.4	47.0	74.3	1.39	61.0	3.45	0	1005	5	4	3	5
Bearpaw	58.8	15.0	27.3	64.1	72.8	1.57	62.1	3.60	1	1075	5	3	5	4
Bill Brown	60.1	13.2	28.4	62.1	72.8	1.48	61.9	4.30	2	965	4	4	5	5
Bond CL	59.3	12.7	29.6	59.0	71.1	1.48	61.8	3.59	4	1025	5	3	5	3
Brawl CL Plus	59.6	15.4	28.9	52.6	72.7	1.43	66.0	3.24	1	1300	5	4	4	1
Byrd	58.9	14.1	25.2	56.9	74.7	1.49	65.0	5.70	5	1320	5	4	4	1
Clara CL	60.7	14.0	30.9	63.8	71.0	1.54	62.8	3.36	2	1090	4	4	5	3
CO09W009	60.7	13.1	32.3	48.7	73.9	1.50	62.8	4.24	3	1075	5	4	3	3
CO09W040-	59.9	12.9	30.9	50.7	74.5	1.30	60.2	2.67	0	960	3	3	3	8
CO11D174	58.7	13.5	28.5	54.4	74.0	1.44	63.7	5.30	5	1235	6	5	4	1
CO11D346	60.0	12.5	31.9	52.5	74.6	1.39	62.0	3.43	3	840	2	2	3	6
CO11D446	59.1	13.1	26.9	58.3	74.1	1.47	62.9	5.56	5	1215	4	4	5	2
Cowboy	59.8	13.7	32.3	53.3	73.8	1.44	63.8	3.36	3	840	2	2	3	5
CSU Blend13	59.8	14.1	28.1	59.3	72.8	1.46	61.9	3.75	2	1075	5	4	5	3
Denali	60.8	13.1	28.5	57.5	73.1	1.43	61.1	2.95	1	870	4	3	3	7
Freeman	57.5	14.4	28.6	46.3	72.2	1.53	63.5	4.83	5	1020	4	3	8	3
Gallagher	59.8	13.5	32.0	66.2	73.8	1.52	62.8	3.74	1	940	4	3	4	5
Hatcher	59.6	14.0	28.9	54.0	72.8	1.42	65.3	3.95	4	1000	5	3	4	1
Iba	60.8	13.4	29.4	56.5	74.0	1.49	62.8	3.61	4	1010	4	4	2	3
KanMark	60.2	14.5	28.2	59.1	74.6	1.46	62.9	3.91	2	1150	5	4	3	2
KS10HW78-1	59.9	13.1	32.7	58.3	75.4	1.52	59.8	2.73	0	815	4	2	2	9
LCH11-1064	58.8	13.9	27.8	65.7	71.2	1.44	61.6	2.26	0	950	3	3	6	8
LCS Mint	60.9	13.5	31.9	52.7	73.2	1.37	63.0	4.01	3	1150	5	4	2	2
LCS Pistol	59.4	14.3	27.3	46.8	68.3	1.60	62.6	2.35	0	1035	3	3	8	7
Oakley CL	59.9	14.4	33.0	69.7	72.4	1.50	64.9	4.08	4	1020	4	4	4	1
Prairie Red	58.2	15.2	27.2	64.8	71.7	1.55	63.3	2.71	2	1065	4	4	7	4
Ripper	57.9	14.3	33.2	55.7	74.4	1.39	63.6	2.64	2	970	4	3	2	5
Robidoux	59.1	14.1	29.3	50.8	73.8	1.43	63.8	3.83	4	1075	5	4	4	1
Settler CL	59.2	13.9	30.3	56.5	72.7	1.58	63.1	3.77	2	1120	4	4	4	3
Snowmass	58.7	13.6	30.4	67.5	71.1	1.45	65.0	7.44	6	1150	5	4	7	2
Sunshine	58.8	15.0	31.8	43.8	71.6	1.39	66.9	5.36	5	1190	4	5	4	1
SY Monument	59.7	13.6	30.9	62.4	74.1	1.42	62.7	5.41	5	1095	5	4	3	3
SY Wolf	59.0	14.5	30.3	59.3	71.8	1.47	59.9	4.58	1	1025	4	4	4	6
T158	59.5	13.5	32.2	51.9	73.8	1.42	59.9	2.70	0	1050	6	5	3	6
TAM 111	59.7	14.5	29.4	56.6	71.9	1.47	63.2	2.75	1	940	3	2	4	7
TAM 112	60.3	15.3	30.3	62.7	69.8	1.61	66.9	3.59	4	1220	4	3	6	1
TAM 113	59.8	14.3	30.0	58.8	72.3	1.51	64.0	3.57	2	1225	4	4	4	1
Warhorse	58.6	15.7	27.1	77.5	70.8	1.47	65.9	3.85	2	1190	4	4	7	1
WB-Grainfield	59.4	12.9	31.6	57.8	74.5	1.38	60.6	3.04	0	1000	4	4	2	6
Winterhawk	60.1	13.8	32.1	58.0	74.2	1.45	62.8	3.47	2	1040	5	5	2	3
Yumar	60.5	13.5	30.8	59.6	72.1	1.45	63.6	3.97	4	1065	5	4	4	2
Average	59.5	13.9	29.9	57.5	72.8	1.47	62.9	3.77	2.4	1054	4.3	3.6		
Minimum	57.5	12.5	25.2	43.8	68.3	1.30	59.8	2.26	0	815	2	2		
Maximum	60.9	15.7	33.2	77.5	75.4	1.61	66.9	7.44	6	1320	6	5		

Wheat Milling and Baking Quality Data - 2014 Fort Collins

 * Value in **bold** indicates superior value, value in *italics* indicates inferior value.

Entry	Test Weight	Grain Protein	SKCS Weight	SKCS Hardness	Flour Yield	Grain Ash	Bake Absorption	Mixograph Mix Time	Mixograph Tolerance	Loaf Volume	Crumb Color	Crumb Grain	Milling Score	Baking Score
Antero	61.1	<i>11.7</i>	37.8	60.0	73.1	1.18	<i>58.0</i>	3.47	2	<i>815</i>	5	3	3	5
Brawl CL Plus	60.9	14.4	<i>34.1</i>	61.6	71.6	1.37	61.9	2.94	1	1130	5	4	4	1
Byrd	60.5	12.4	35.8	<i>59.3</i>	75.6	1.29	59.7	4.04	4	1095	5	4	3	1
CO09W009	62.4	12.7	37.2	60.8	<i>71.0</i>	1.33	<i>58.0</i>	3.55	2	1040	6	4	3	2
CO09W040-	61.5	12.3	39.2	<i>59.4</i>	72.7	1.28	59.0	2.74	2	910	5	4	3	4
CO11D174	60.9	12.2	37.2	63.1	74.3	1.26	60.9	4.90	3	1075	6	4	3	2
CO11D346	60.1	<i>10.8</i>	38.6	<i>48.9</i>	75.0	1.27	<i>57.7</i>	3.29	3	725	4	3	4	5
CO11D446	60.2	12.4	<i>34.3</i>	65.4	73.8	1.33	59.6	3.90	3	1075	5	4	4	1
Cowboy	61.0	<i>11.6</i>	36.4	<i>54.3</i>	73.4	1.30	58.9	3.56	3	760	4	3	5	5
Denali	61.8	<i>11.6</i>	36.3	<i>57.3</i>	73.1	<i>1.39</i>	<i>57.0</i>	2.92	2	740	4	3	4	7
Freeman	<i>58.4</i>	12.8	<i>33.3</i>	<i>44.1</i>	72.1	1.26	58.7	3.95	2	955	5	4	9	4
Hatcher	60.7	12.0	35.2	60.3	72.4	1.21	59.7	4.09	4	840	5	5	4	3
Iba	61.7	12.9	35.2	59.5	73.2	1.39	60.1	3.60	2	915	4	4	3	3
KanMark	61.8	13.1	32.3	68.2	73.1	1.35	61.0	3.70	3	1040	5	5	5	1
LCH11-1064	60.3	12.7	37.9	67.1	<i>70.5</i>	1.38	59.6	1.82	0	890	4	4	5	6
LCS Mint	62.2	12.5	37.6	62.8	73.7	1.25	61.0	4.14	3	1035	5	4	1	1
LCS Pistol	60.6	13.1	32.9	<i>47.3</i>	<i>67.9</i>	<i>1.44</i>	58.7	<i>1.74</i>	0	1005	5	3	8	6
Oakley CL	61.3	13.8	39.8	68.8	72.2	1.39	62.9	3.67	3	1065	6	4	3	1
Robidoux	60.8	12.6	32.7	63.3	73.4	1.23	58.9	4.03	2	915	5	5	4	4
Settler CL	60.7	12.6	38.5	66.8	72.1	<i>1.41</i>	61.0	3.84	4	925	5	4	4	1
Snowmass	61.4	12.7	42.1	76.8	<i>70.4</i>	1.33	62.1	6.87	6	825	5	4	5	4
Sunshine	60.6	13.1	42.0	<i>55.5</i>	72.0	1.33	62.1	4.27	3	1040	5	4	3	1
SY Southwind	<i>59.4</i>	12.2	29.7	67.7	74.5	1.29	59.9	2.58	3	955	4	4	6	4
SY Wolf	61.2	13.6	34.7	70.5	72.1	<i>1.48</i>	59.1	3.31	1	990	4	4	6	4
T158	61.4	13.2	37.2	59.9	71.8	1.35	56.9	2.16	1	915	5	4	4	6
Thunder CL	60.5	12.9	35.1	64.0	72.2	1.28	61.1	4.55	4	1050	5	4	4	1
WB-Cedar	<i>59.5</i>	13.7	38.0	<i>58.4</i>	69.6	1.33	60.0	2.19	0	855	5	3	6	6
WB-Grainfield	60.8	12.1	37.1	61.1	72.4	1.30	58.8	2.38	1	945	5	4	3	5
Winterhawk	61.1	12.8	39.0	63.9	72.4	1.37	59.9	3.19	2	915	5	5	3	3
Yuma	61.2	<i>11.5</i>	36.6	65.9	71.8	1.32	58.6	2.68	3	825	6	5	5	4

Average	60.9	12.6	36.5	61.4	72.4	1.32	59.7	3.47	2.4	942	4.9	4.0		
Minimum	58.4	10.8	29.7	44.1	67.9	1.18	56.9	1.74	0	725	4	3		
Maximum	62.4	14.4	42.1	76.8	75.6	1.48	62.9	6.87	6	1130	6	5		

Wheat Milling and Baking Quality Data - 2014 Haxtun

 * Value in **bold** indicates superior value, value in *italics* indicates inferior value.

Entry	Test Weight	Grain Protein	SKCS Weight	SKCS Hardness	Flour Yield	Grain Ash	Bake Absorption	Mixograph Mix Time	Mixograph Tolerance	Loaf Volume	Crumb Color	Crumb Grain	Milling Score	Baking Score
Antero	59.1	<i>10.7</i>	34.9	<i>49.2</i>	74.6	1.43	<i>56.1</i>	3.95	2	<i>755</i>	2	2	4	8
Brawl CL Plus	59.4	13.3	29.7	63.1	73.7	1.48	63.4	3.62	3	1045	4	3	5	1
Byrd	58.3	12.3	<i>29.0</i>	63.6	75.6	1.48	61.1	4.74	5	995	4	3	6	1
CO09W009	60.2	11.7	35.2	61.0	73.0	1.54	59.4	4.51	4	995	4	4	4	1
CO09W040-	60.4	<i>10.2</i>	34.0	<i>53.3</i>	74.9	1.36	<i>56.2</i>	4.35	2	<i>725</i>	2	2	3	7
CO11D174	58.8	<i>10.3</i>	34.9	<i>51.5</i>	74.9	1.48	58.2	<i>6.81</i>	4	960	3	4	4	5
CO11D346	58.6	<i>10.3</i>	35.7	<i>49.7</i>	75.2	1.50	<i>57.1</i>	5.20	3	<i>720</i>	2	2	4	7
CO11D446	58.6	<i>10.9</i>	33.6	<i>53.7</i>	74.5	1.52	58.1	<i>7.38</i>	6	880	4	3	4	5
Cowboy	58.9	11.5	32.3	<i>58.9</i>	73.7	1.50	58.1	4.33	2	<i>800</i>	2	2	4	5
Denali	59.6	12.3	32.5	60.6	73.3	1.51	59.2	2.66	2	<i>790</i>	3	2	4	7
Freeman	<i>57.3</i>	<i>10.3</i>	35.2	<i>38.6</i>	73.9	1.49	<i>57.1</i>	4.63	4	825	3	3	7	4
Hatcher	58.7	13.1	<i>32.1</i>	61.3	<i>72.4</i>	1.48	62.2	3.00	4	950	5	3	5	2
Iba	60.3	12.0	32.8	<i>54.4</i>	75.4	1.47	60.2	4.81	3	930	3	2	3	3
KanMark	60.0	13.0	<i>30.8</i>	68.7	74.3	1.47	63.3	3.92	4	1060	5	4	5	1
LCH11-1064	59.5	12.8	34.4	77.4	<i>71.9</i>	1.52	60.1	2.85	<i>1</i>	<i>785</i>	3	2	6	7
LCS Mint	60.7	11.0	36.4	<i>48.5</i>	74.4	1.51	58.2	4.79	3	910	4	4	3	3
LCS Pistol	59.3	12.7	<i>30.2</i>	<i>54.3</i>	69.8	1.56	58.1	2.91	<i>1</i>	<i>810</i>	3	2	7	7
Oakley CL	59.2	12.7	37.0	69.3	73.8	1.53	61.5	3.75	3	990	4	4	4	1
Robidoux	59.1	<i>10.8</i>	35.0	<i>56.4</i>	73.5	1.55	58.3	4.70	4	915	4	3	4	3
Settler CL	59.6	11.7	34.8	<i>59.3</i>	74.4	1.56	59.1	5.14	4	875	4	3	3	3
Sunshine	58.9	<i>10.8</i>	40.4	<i>44.8</i>	74.2	1.47	58.2	5.72	5	900	4	4	4	3
SY Southwind	<i>56.9</i>	12.1	<i>26.9</i>	64.0	75.2	1.49	60.6	3.40	3	935	4	3	7	3
SY Wolf	60.6	12.1	34.6	72.8	74.3	<i>1.58</i>	59.3	5.19	3	845	3	3	3	5
T158	58.5	11.2	37.0	<i>53.5</i>	75.1	1.50	<i>57.2</i>	3.95	2	860	3	3	2	5
Thunder CL	58.3	11.6	33.1	63.4	73.4	1.38	60.3	4.37	4	940	4	4	5	1
WB-Cedar	58.8	11.4	38.5	<i>58.3</i>	73.6	1.46	58.2	4.40	2	<i>800</i>	3	3	2	5
WB-Grainfield	60.1	10.9	35.0	<i>56.1</i>	74.2	1.47	58.1	5.25	3	<i>795</i>	2	2	3	6
Yuma	59.5	11.8	33.5	63.6	73.2	1.53	60.4	3.46	4	875	5	3	5	2

Average	59.2	11.6	33.9	58.2	73.9	1.49	59.2	4.42	3.2	881	3.4	2.9		
Minimum	56.9	10.2	26.9	38.6	69.8	1.36	56.1	2.66	1	720	2	2		
Maximum	60.7	13.3	40.4	77.4	75.6	1.58	63.4	7.38	6	1060	5	4		