

Wheat Quality Evaluations from the 2019 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 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 taken into account (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 2019, grain samples were collected from each of the dryland (UVPT) and irrigated (IVPT) variety trial locations. Preliminary small-scale 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, Burlington, Walsh, Yuma

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. From 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 (>30 grams per 1000 kernels, or <15,133 seeds per pound) 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 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 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 with the CWRP 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. In general, bakers 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 as a means 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 of 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 - 2019 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
AM Eastwood	58.8	12.2	29.8	<u>58.7</u>	70.4	-0.4	61.9	3.49	<u>2</u>	<u>900</u>	5	4	3	6
Antero	58.3	<u>12.1</u>	29.5	<u>55.8</u>	71.3	-0.6	61.9	4.18	3	<u>885</u>	<u>2</u>	<u>2</u>	4	7
Avery	56.9	12.2	28.4	60.3	70.1	-0.6	62.1	5.31	4	1090	5	4	5	2
Brawl CL Plus	58.7	13.4	28.0	66.8	70.1	-0.2	64.2	3.77	<u>2</u>	1105	4	4	3	3
Breck	60.4	12.7	27.0	60.5	72.2	-0.5	63.1	4.17	3	1090	5	3	1	3
Byrd	57.0	12.5	27.9	<u>58.2</u>	71.8	-0.6	63.2	6.25	5	1095	5	4	4	1
Byrd CL Plus	<u>56.7</u>	12.5	29.6	<u>57.0</u>	70.5	-0.4	62.9	3.64	3	985	<u>2</u>	3	5	5
Canvas	59.0	13.2	<u>25.9</u>	64.8	72.2	<u>-1.0</u>	63.3	4.29	4	1050	4	4	3	3
CO13D0346	57.1	12.8	28.9	68.0	69.5	-0.8	63.0	4.65	4	1025	4	3	6	4
CO13D1479	58.5	12.5	26.6	67.0	70.4	-0.5	62.9	6.50	4	1040	4	4	5	2
CO15D098R	58.6	12.7	28.3	<u>56.8</u>	71.0	<u>-1.2</u>	62.2	4.02	3	1090	3	3	5	4
CO15SFD092	57.8	<u>12.1</u>	26.4	<u>54.8</u>	72.0	-0.6	<u>61.3</u>	3.79	<u>2</u>	1000	<u>2</u>	4	5	6
Crescent AX	58.9	<u>12.0</u>	28.1	62.4	71.4	-0.1	62.6	4.70	4	1100	5	5	3	2
Denali	57.7	13.1	27.2	60.0	69.5	<u>-0.9</u>	63.2	<u>3.16</u>	3	940	<u>2</u>	<u>2</u>	5	6
Fortify SF	58.7	12.2	<u>25.3</u>	<u>55.9</u>	72.1	-0.9	<u>60.1</u>	3.84	<u>1</u>	1055	5	3	5	7
Guardian	<u>56.5</u>	13.6	<u>25.8</u>	63.0	70.0	-0.8	64.1	5.35	5	1105	4	4	5	1
Hatcher	58.6	<u>11.5</u>	31.2	60.1	70.1	-0.8	<u>61.1</u>	4.91	4	990	6	5	4	3
Incline AX	<u>56.4</u>	12.8	<u>26.1</u>	69.1	<u>68.0</u>	<u>-1.3</u>	62.0	4.18	3	1095	4	3	<u>9</u>	3
Langin	57.2	<u>12.1</u>	27.7	<u>57.4</u>	71.2	-0.7	63.2	5.65	5	1055	4	4	5	1
LCH15ACC-7-7	60.0	13.1	32.6	60.8	72.5	-0.8	62.2	<u>2.93</u>	<u>2</u>	950	3	3	1	6
LCS Valiant	58.4	13.1	29.6	<u>59.9</u>	70.2	0.0	65.0	<u>3.22</u>	3	935	3	<u>1</u>	3	5
Long Branch	58.3	12.3	30.9	62.4	69.7	-0.5	61.9	<u>3.25</u>	<u>2</u>	1005	5	4	3	5
Monarch	58.0	<u>11.7</u>	26.9	67.7	70.2	0.1	63.0	4.91	4	1035	4	3	5	3
Snowmass	58.1	12.6	31.3	64.4	70.1	-0.4	62.9	6.23	5	1105	4	4	3	1
Snowmass 2.0	57.8	12.3	29.3	60.2	70.6	-0.1	63.1	5.67	5	1065	6	5	4	1
Sunshine	59.2	<u>11.8</u>	29.4	<u>52.2</u>	71.0	-0.6	<u>61.0</u>	4.03	<u>2</u>	<u>930</u>	4	3	5	6
SY Legend CL2	57.4	13.5	28.1	68.8	<u>68.4</u>	-0.9	63.9	3.75	3	950	3	3	6	5
SY Monument	<u>56.5</u>	12.7	27.8	67.8	70.7	-0.4	63.2	5.92	5	1015	5	3	6	2
SY Rugged	58.3	12.7	32.8	61.9	71.7	-0.7	62.0	3.93	3	995	4	3	1	4
SY Spur	<u>55.0</u>	13.5	<u>26.1</u>	72.2	<u>69.0</u>	-0.8	64.1	5.74	5	1135	5	3	<u>9</u>	1
SY Wolf	58.3	13.3	27.1	67.8	70.1	-0.7	<u>61.1</u>	4.43	<u>1</u>	995	4	3	4	6
SY Wolverine	59.4	12.8	29.3	60.4	71.0	-0.1	61.8	4.16	<u>1</u>	950	<u>2</u>	<u>2</u>	2	7
WB-Grainfield	59.0	12.7	29.8	61.1	70.7	-0.3	61.8	<u>3.01</u>	<u>1</u>	<u>925</u>	<u>2</u>	<u>2</u>	3	8
WB4418	57.5	12.6	<u>24.5</u>	75.3	<u>68.3</u>	-0.4	64.1	3.82	3	1020	4	4	<u>8</u>	4
WB4462	59.1	12.8	32.5	<u>58.6</u>	71.2	-0.5	62.0	3.57	<u>2</u>	950	4	3	2	6
WB4595	61.2	<u>11.9</u>	28.9	71.1	70.1	-0.5	<u>59.9</u>	<u>2.91</u>	<u>1</u>	<u>840</u>	4	3	3	<u>9</u>
WB4792	59.6	12.7	28.5	67.5	70.4	-0.7	<u>60.9</u>	3.42	<u>2</u>	<u>850</u>	4	<u>2</u>	3	<u>8</u>
Whistler	<u>56.2</u>	12.7	26.7	62.5	69.5	<u>-0.9</u>	64.1	6.04	5	1085	3	4	<u>7</u>	1

Average	58.1	12.6	28.4	62.6	70.5	-0.6	62.5	4.39	3.1	1011	3.9	3.3		
Minimum	55.0	11.5	24.5	52.2	68.0	-1.3	59.9	2.91	1	840	2	1		
Maximum	61.2	13.6	32.8	75.3	72.5	0.1	65.0	6.50	5	1135	6	5		

Wheat Milling and Baking Quality Data - 2019 UVPT 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
AM Eastwood	59.9	11.8	30.2	61.7	<u>70.0</u>	-0.5	62.1	3.81	4	890	5	4	5	4
Antero	60.2	11.7	33.0	<u>59.4</u>	72.3	-1.1	<u>60.2</u>	4.07	4	825	4	4	5	5
Avery	<u>58.4</u>	12.3	27.5	70.4	72.2	-0.8	62.2	5.18	4	975	5	5	5	3
Brawl CL Plus	61.0	12.8	31.7	69.1	71.1	-0.6	64.2	4.35	4	1035	4	4	2	1
Breck	61.4	12.5	28.4	69.8	73.2	-0.5	65.0	4.45	4	940	5	4	1	1
Byrd	<u>58.6</u>	12.3	<u>26.5</u>	70.7	73.8	-1.0	62.4	6.66	5	1010	4	5	5	1
Byrd CL Plus	59.1	11.9	29.8	66.8	72.4	-1.1	61.2	4.78	4	880	3	3	5	4
Canvas	60.1	<u>11.5</u>	<u>26.1</u>	69.3	74.3	-0.1	63.3	4.73	5	865	4	3	3	3
CO13D0346	<u>57.9</u>	12.2	<u>27.3</u>	74.3	<u>69.8</u>	-0.7	60.9	5.30	4	875	3	3	<u>8</u>	4
CO13D1479	59.0	12.5	<u>26.7</u>	74.8	<u>70.2</u>	-0.6	62.8	7.72	5	955	4	4	6	1
CO15D098R	60.4	12.0	32.0	65.9	72.6	-0.6	62.2	3.99	4	965	4	4	3	3
CO15SFD092	59.9	11.8	<u>27.3</u>	63.0	73.6	-0.7	61.1	4.78	4	880	<u>2</u>	3	5	5
Crescent AX	61.1	12.0	35.1	62.0	72.6	<u>-1.3</u>	61.2	5.45	5	920	5	5	3	3
Denali	60.9	12.1	31.2	64.1	72.3	-1.0	61.4	<u>3.41</u>	3	<u>750</u>	<u>2</u>	3	4	<u>7</u>
Fortify SF	60.4	11.7	29.4	<u>57.1</u>	73.8	-0.8	61.1	4.88	4	925	5	5	4	3
Guardian	59.3	13.2	<u>26.0</u>	72.0	71.7	<u>-1.1</u>	63.2	5.23	5	995	4	4	5	2
Hatcher	59.5	<u>11.2</u>	29.2	66.6	72.3	-0.4	61.5	3.60	4	845	5	3	5	4
Incline AX	60.5	11.7	31.7	73.0	71.0	-0.9	61.1	5.10	4	890	5	5	4	3
Langin	<u>58.7</u>	12.0	28.9	65.7	73.1	<u>-1.1</u>	61.4	6.71	5	970	5	5	5	2
LCH15ACC-7-7	61.4	12.2	36.6	63.3	73.7	-1.0	63.0	4.18	4	870	3	3	1	4
LCS Valiant	60.2	12.8	31.6	72.5	70.5	-0.7	62.9	<u>3.20</u>	3	875	4	3	3	5
Long Branch	59.9	12.2	32.7	70.3	70.4	<u>-1.1</u>	61.1	3.94	3	825	3	3	4	6
Monarch	59.7	11.6	29.6	70.5	71.3	-0.7	61.1	4.54	4	855	4	4	4	4
Snowmass	59.9	11.9	32.1	73.3	<u>70.3</u>	-0.6	65.0	8.10	6	980	4	5	4	1
Snowmass 2.0	59.9	11.9	31.0	73.0	71.6	-0.7	63.1	8.05	6	915	5	6	4	1
Sunshine	60.0	12.1	30.5	62.1	72.7	-0.9	62.0	4.17	4	<u>805</u>	3	3	4	5
SY Legend CL2	60.1	<u>11.5</u>	30.0	73.7	<u>69.3</u>	-0.8	61.0	<u>3.29</u>	3	850	3	<u>2</u>	6	6
SY Monument	60.0	12.3	32.0	78.9	72.7	-1.0	64.1	6.02	5	950	4	4	4	1
SY Rugged	60.8	<u>11.5</u>	34.2	70.9	72.4	-1.1	<u>60.2</u>	5.01	4	945	5	3	3	4
SY Spur	<u>57.0</u>	12.4	<u>26.8</u>	78.1	<u>69.6</u>	-0.9	63.2	5.12	5	1050	4	5	<u>9</u>	1
SY Wolf	61.2	12.8	31.8	74.0	71.5	-0.9	61.2	4.64	<u>2</u>	910	<u>2</u>	3	2	6
SY Wolverine	60.1	13.9	29.1	65.9	71.6	-1.0	61.9	4.47	<u>2</u>	925	4	4	4	5
WB-Grainfield	61.2	11.8	31.0	68.5	72.4	-1.1	61.1	3.98	3	825	<u>2</u>	<u>2</u>	3	6
WB4418	59.5	11.8	<u>25.8</u>	78.4	<u>68.9</u>	-1.0	62.2	4.99	4	910	4	3	<u>8</u>	4
WB4462	61.1	12.9	35.7	67.2	71.3	-1.0	63.0	4.12	3	875	5	4	2	4
WB4595	62.7	<u>11.3</u>	30.5	79.6	70.6	-0.9	<u>59.0</u>	<u>3.21</u>	<u>2</u>	<u>710</u>	4	3	4	<u>9</u>
WB4792	62.3	11.7	31.8	77.5	71.4	-0.8	61.1	<u>2.42</u>	3	<u>735</u>	3	<u>2</u>	3	<u>8</u>
Whistler	<u>58.8</u>	12.1	<u>27.1</u>	73.2	71.7	-1.1	64.3	6.17	5	1010	3	4	6	1

Average	60.1	12.1	30.2	69.6	71.7	-0.8	62.1	4.84	4.0	900	3.9	3.7		
Minimum	57.0	11.2	25.8	57.1	68.9	-1.3	59.0	2.42	2	710	2	2		
Maximum	62.7	13.9	36.6	79.6	74.3	-0.1	65.0	8.10	6	1050	5	6		

Wheat Milling and Baking Quality Data - 2019 UVPT Walsh

* **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
AM Eastwood	<u>56.4</u>	12.5	26.8	<u>50.5</u>	68.8	-0.9	62.4	3.98	3	975	4	4	6	3
Antero	58.1	11.7	28.7	<u>45.5</u>	71.5	-0.7	60.5	4.87	4	890	3	3	4	4
Avery	58.0	<u>9.6</u>	28.9	<u>46.2</u>	69.5	-0.6	<u>57.2</u>	4.94	3	880	5	3	5	6
Brawl CL Plus	58.9	13.0	30.7	<u>51.3</u>	70.5	-0.8	61.3	4.49	<u>2</u>	1045	5	4	1	3
Breck	59.1	12.6	28.3	<u>51.5</u>	72.2	-0.7	61.3	3.87	<u>2</u>	1050	5	4	1	3
Byrd	57.5	<u>10.2</u>	27.2	<u>49.8</u>	71.6	-0.8	58.4	4.38	4	925	4	4	4	4
Byrd CL Plus	56.6	10.9	26.5	<u>56.3</u>	69.6	-0.8	60.0	5.31	3	920	3	3	5	5
Canvas	59.1	11.3	26.1	<u>53.4</u>	72.2	-0.7	59.5	4.95	3	985	5	4	2	3
CO13D0346	<u>56.2</u>	11.2	27.5	<u>57.1</u>	69.1	<u>-1.4</u>	58.2	4.96	3	900	3	3	6	5
CO13D1479	57.5	11.7	27.7	<u>57.8</u>	68.6	<u>-1.4</u>	60.4	6.53	4	975	4	5	5	2
CO15D098R	59.6	<u>9.9</u>	29.9	<u>50.8</u>	70.4	-0.3	58.4	4.51	3	970	4	4	2	4
CO15SFD092	57.2	<u>10.4</u>	<u>24.9</u>	<u>45.0</u>	71.3	-0.7	58.3	3.87	3	860	<u>2</u>	<u>2</u>	5	6
Crescent AX	58.4	11.5	33.3	<u>48.7</u>	71.0	<u>-1.4</u>	60.2	6.87	4	1025	5	5	2	1
Denali	58.9	10.7	29.3	<u>50.8</u>	68.8	<u>-1.2</u>	<u>57.4</u>	3.48	<u>2</u>	<u>775</u>	3	<u>2</u>	4	<u>9</u>
Fortify SF	56.7	10.9	<u>24.0</u>	<u>41.2</u>	71.7	-1.0	58.3	3.89	<u>2</u>	950	3	3	6	6
Guardian	58.3	11.9	25.8	60.5	70.6	<u>-1.5</u>	60.3	5.54	4	1005	5	3	4	3
Hatcher	57.7	<u>10.2</u>	30.1	<u>47.3</u>	69.1	-1.0	<u>58.1</u>	4.24	4	<u>800</u>	5	3	5	5
Incline AX	<u>56.4</u>	10.7	<u>24.2</u>	65.1	<u>67.1</u>	-0.9	59.3	5.09	4	985	4	4	<u>9</u>	3
Langin	56.6	<u>10.3</u>	28.1	<u>46.7</u>	70.5	-1.0	58.4	8.92	5	955	4	4	5	2
LCH15ACC-7-7	58.2	10.9	31.8	<u>48.4</u>	71.3	-0.8	61.2	3.49	4	860	4	3	3	4
LCS Valiant	58.2	11.2	32.4	<u>54.2</u>	69.0	-0.8	59.4	3.56	<u>2</u>	<u>855</u>	5	3	2	6
Long Branch	<u>56.5</u>	11.8	27.2	62.9	68.7	-0.5	59.4	<u>3.18</u>	<u>2</u>	860	4	3	6	6
Monarch	57.1	11.1	25.9	<u>58.1</u>	69.7	-0.5	59.3	5.69	4	975	4	4	4	3
Snowmass	57.2	11.3	31.1	63.3	<u>67.3</u>	-1.1	62.5	9.21	6	985	4	5	5	1
Snowmass 2.0	57.4	11.2	29.3	<u>55.7</u>	70.0	-0.8	60.5	8.30	5	970	6	6	4	1
Sunshine	57.9	11.4	28.7	<u>43.4</u>	71.4	-1.0	59.6	4.44	3	<u>850</u>	3	3	5	5
SY Legend CL2	58.1	12.1	27.9	64.2	<u>66.7</u>	-0.8	62.1	4.18	4	970	3	<u>2</u>	6	3
SY Monument	57.3	<u>10.3</u>	27.9	63.1	70.3	-0.2	59.4	5.72	5	990	4	4	5	2
SY Rugged	57.7	11.2	31.3	<u>51.5</u>	71.8	-0.6	60.4	4.85	3	1005	4	3	2	3
SY Spur	<u>54.5</u>	11.7	<u>25.1</u>	74.0	<u>66.4</u>	-0.4	62.2	5.03	5	1145	4	5	<u>9</u>	1
SY Wolf	58.1	13.3	28.2	<u>59.3</u>	68.5	<u>-1.3</u>	58.5	4.91	<u>1</u>	970	<u>2</u>	3	4	6
SY Wolverine	59.4	11.2	29.5	<u>50.0</u>	70.5	-0.7	<u>57.2</u>	4.46	<u>1</u>	885	4	<u>2</u>	2	<u>7</u>
WB-Grainfield	57.5	11.6	28.5	<u>53.5</u>	70.1	-0.6	60.2	3.80	<u>2</u>	910	<u>2</u>	<u>2</u>	4	6
WB4418	<u>55.6</u>	11.0	<u>24.9</u>	<u>47.5</u>	<u>66.8</u>	-0.2	61.3	4.32	3	990	4	3	<u>8</u>	3
WB4462	57.7	11.6	32.5	<u>53.9</u>	69.5	-0.3	59.3	<u>3.21</u>	<u>1</u>	900	6	3	2	6
WB4595	60.7	10.9	25.7	68.7	<u>67.5</u>	-0.5	<u>58.0</u>	<u>3.09</u>	<u>1</u>	<u>775</u>	3	<u>2</u>	4	<u>9</u>
WB4792	59.2	11.2	<u>25.1</u>	67.6	68.3	-0.9	<u>58.1</u>	3.50	<u>1</u>	<u>800</u>	4	<u>2</u>	5	<u>8</u>
Whistler	57.0	11.0	<u>24.9</u>	67.7	68.3	-1.0	59.3	6.42	5	950	4	5	<u>7</u>	2

Average	57.7	11.2	28.0	54.8	69.6	-0.8	59.6	4.90	3.2	935	3.9	3.4		
Minimum	54.5	9.6	24.0	41.2	66.4	-1.5	57.2	3.09	1	775	2	2		
Maximum	60.7	13.3	33.3	74.0	72.2	-0.2	62.5	9.21	6	1145	6	6		

Wheat Milling and Baking Quality Data - 2019 UVPT Yuma

* **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
AM Eastwood	60.8	11.3	30.1	65.7	68.4	-0.9	60.1	4.09	3	815	5	4	3	4
Antero	60.4	<u>10.6</u>	31.7	64.4	70.3	-0.9	59.4	4.02	3	765	<u>2</u>	3	3	6
Avery	<u>56.7</u>	11.9	24.9	66.4	68.8	-0.6	62.9	4.89	5	900	4	3	5	2
Brawl CL Plus	60.9	12.0	29.7	72.0	69.2	-0.4	62.4	4.39	3	880	4	4	2	3
Breck	60.7	12.3	26.5	71.6	70.4	-0.2	64.2	3.61	3	875	5	3	1	2
Byrd	<u>57.0</u>	12.3	<u>24.2</u>	68.4	71.5	<u>-1.2</u>	62.0	4.66	5	925	4	5	5	1
Byrd CL Plus	58.3	<u>10.4</u>	28.4	60.9	69.7	-0.9	<u>58.5</u>	4.60	4	780	3	<u>2</u>	6	5
Canvas	58.7	12.7	25.4	69.0	72.5	-1.0	62.0	4.01	4	825	3	<u>2</u>	2	4
CO13D0346	<u>57.1</u>	11.2	25.4	79.1	<u>66.8</u>	-0.4	61.1	4.41	4	785	3	3	<u>7</u>	4
CO13D1479	57.4	12.4	<u>24.4</u>	70.7	<u>66.9</u>	<u>-1.1</u>	62.1	6.82	5	885	4	5	6	1
CO15D098R	60.1	10.8	27.4	68.3	70.6	-0.8	60.0	5.06	4	785	3	3	3	4
CO15SFD092	59.1	10.6	24.8	62.0	72.2	-0.5	59.0	3.96	3	790	3	<u>2</u>	4	6
Crescent AX	60.3	<u>10.3</u>	30.8	64.4	70.3	<u>-1.1</u>	<u>58.3</u>	4.66	4	840	5	4	3	4
Denali	59.0	13.1	27.3	67.9	69.4	<u>-1.4</u>	62.1	<u>3.21</u>	3	<u>750</u>	<u>2</u>	<u>1</u>	4	<u>7</u>
Fortify SF	59.4	<u>10.4</u>	25.9	<u>59.4</u>	71.1	-0.6	59.0	4.17	3	785	3	3	5	5
Guardian	58.1	11.6	<u>24.7</u>	67.8	69.7	-0.6	60.9	5.05	4	890	4	4	5	3
Hatcher	58.6	11.5	27.5	69.1	69.6	-0.9	61.0	3.89	3	785	3	3	4	5
Incline AX	57.4	10.7	<u>23.9</u>	73.8	<u>66.9</u>	-1.0	<u>58.4</u>	4.01	<u>2</u>	770	4	3	<u>7</u>	6
Langin	<u>56.5</u>	11.8	<u>24.1</u>	63.3	70.1	-0.9	61.0	5.27	5	925	4	3	6	2
LCH15ACC-7-7	60.1	10.7	32.1	64.1	71.6	-0.6	59.3	4.03	4	810	4	3	2	4
LCS Valiant	60.4	11.9	29.2	76.8	<u>67.1</u>	-0.9	61.2	<u>2.95</u>	3	765	5	3	4	5
Long Branch	59.9	11.3	29.5	75.2	68.1	-0.7	60.1	3.46	3	<u>750</u>	4	3	4	5
Monarch	<u>56.8</u>	12.5	<u>24.0</u>	71.7	68.1	-0.8	63.0	4.99	4	870	4	3	6	3
Snowmass	57.9	10.7	27.7	74.3	<u>66.7</u>	-0.7	61.9	8.39	5	915	5	6	6	1
Snowmass 2.0	59.0	11.2	29.5	72.0	<u>67.1</u>	-0.6	62.1	7.18	5	850	6	5	4	1
Sunshine	59.8	11.5	29.1	65.3	70.4	<u>-1.1</u>	60.3	3.99	3	760	3	<u>1</u>	4	6
SY Legend CL2	58.6	11.8	29.3	72.6	<u>66.9</u>	-0.5	62.1	3.82	4	855	3	3	4	4
SY Monument	58.2	11.1	25.6	76.9	69.9	-0.6	60.4	6.12	5	820	4	3	5	2
SY Rugged	59.4	11.2	30.6	70.3	70.4	-1.0	60.3	5.59	4	875	5	5	3	2
SY Spur	<u>55.8</u>	11.0	<u>23.9</u>	77.9	67.9	-0.6	59.9	3.93	4	855	4	3	<u>8</u>	4
SY Wolf	60.8	11.0	27.5	74.9	70.0	-0.9	<u>57.3</u>	4.49	<u>2</u>	815	<u>2</u>	3	3	<u>7</u>
SY Wolverine	61.4	11.3	30.1	71.5	70.6	-0.7	58.9	4.44	<u>2</u>	760	4	3	1	6
WB-Grainfield	59.6	<u>10.6</u>	27.9	72.9	69.4	-0.5	<u>58.3</u>	4.21	3	775	<u>2</u>	<u>2</u>	4	6
WB4418	58.4	11.6	<u>23.4</u>	78.5	<u>66.8</u>	-0.5	62.2	4.73	3	845	4	3	<u>7</u>	4
WB4462	60.5	12.1	31.5	68.4	69.3	-0.8	61.3	4.25	3	825	6	4	2	3
WB4595	62.0	<u>10.4</u>	28.2	75.4	69.0	-0.7	<u>57.1</u>	<u>3.16</u>	<u>2</u>	<u>625</u>	3	<u>1</u>	3	<u>9</u>
WB4792	61.1	<u>10.2</u>	28.1	76.0	69.6	-0.7	<u>58.1</u>	3.53	3	<u>720</u>	6	<u>2</u>	4	6
Whistler	<u>54.3</u>	12.2	<u>24.1</u>	67.9	<u>67.6</u>	-1.0	61.7	6.11	5	915	3	4	<u>8</u>	1

Average	59.0	11.4	27.3	70.2	69.2	-0.8	60.5	4.58	3.6	820	3.8	3.2		
Minimum	54.3	10.2	23.4	59.4	66.7	-1.4	57.1	2.95	2	625	2	1		
Maximum	62.0	13.1	32.1	79.1	72.5	-0.2	64.2	8.39	5	925	6	6		

Summary of composite milling and baking quality scores from four 2019 Uniform Variety Trial (UVPT) locations. Entries are ranked in ascending order (from 1=good to 9=poor) by the average baking quality score across all four trial locations.

Entry	Baking Quality Scores					Milling Quality Scores				
	Akron	Burlington	Walsh	Yuma	Average	Akron	Burlington	Walsh	Yuma	Average
Snowmass	1	1	1	1	1.0	3	4	5	6	4.5
Snowmass 2.0	1	1	1	1	1.0	4	4	4	4	4.0
Whistler	1	1	2	1	1.3	7	6	7	8	7.0
CO13D1479	2	1	2	1	1.5	5	6	5	6	5.5
Byrd	1	1	4	1	1.8	4	5	4	5	4.5
Langin	1	2	2	2	1.8	5	5	5	6	5.3
Spur	1	1	1	4	1.8	9	9	9	8	8.8
SY Monument	2	1	2	2	1.8	6	4	5	5	5.0
Breck	3	1	3	2	2.3	1	1	1	1	1.0
Guardian	1	2	3	3	2.3	5	5	4	5	4.8
Brawl CL Plus	3	1	3	3	2.5	3	2	1	2	2.0
Crescent AX	2	3	1	4	2.5	3	3	2	3	2.8
Avery	2	3	6	2	3.3	5	5	5	5	5.0
Canvas	3	3	3	4	3.3	3	3	2	2	2.5
Monarch	3	4	3	3	3.3	5	4	4	6	4.8
SY Rugged	4	4	3	2	3.3	1	3	2	3	2.3
CO15D098R	4	3	4	4	3.8	5	3	2	3	3.3
Incline AX	3	3	3	6	3.8	9	4	9	7	7.3
WB4418	4	4	3	4	3.8	8	8	8	7	7.8
AM Eastwood	6	4	3	4	4.3	3	5	6	3	4.3
CO13D0346	4	4	5	4	4.3	6	8	6	7	6.8
Hatcher	3	4	5	5	4.3	4	5	5	4	4.5
LCH15ACC-7-7	6	4	4	4	4.5	1	1	3	2	1.8
SY Legend CL2	5	6	3	4	4.5	6	6	6	4	5.5
Byrd CL Plus	5	4	5	5	4.8	5	5	5	6	5.3
WB4462	6	4	6	3	4.8	2	2	2	2	2.0
Fortify SF	7	3	6	5	5.3	5	4	6	5	5.0
LCS Valiant	5	5	6	5	5.3	3	3	2	4	3.0
Antero	7	5	4	6	5.5	4	5	4	3	4.0
Long Branch	5	6	6	5	5.5	3	4	6	4	4.3
Sunshine	6	5	5	6	5.5	5	4	5	4	4.5
CO15SFD092	6	5	6	6	5.8	5	5	5	4	4.8
SY Wolf	6	6	6	7	6.3	4	2	4	3	3.3
SY Wolverine	7	5	7	6	6.3	2	4	2	1	2.3
WB-Grainfield	8	6	6	6	6.5	3	3	4	4	3.5
Denali	6	7	9	7	7.3	5	4	4	4	4.3
WB4792	8	8	8	6	7.5	3	3	5	4	3.8
WB4595	9	9	9	9	9.0	3	4	4	3	3.5

Wheat Milling and Baking Quality Data - 2019 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
AM Eastwood	53.3	13.1	25.7	70.1	<u>65.1</u>	-0.9	64.2	4.20	4	980	5	4	6	3
Brawl CL Plus	57.0	13.8	29.6	63.7	70.4	-0.9	66.1	5.01	5	1035	5	4	2	1
Breck	54.5	13.9	26.6	65.1	70.0	-0.6	66.2	4.93	5	935	4	3	3	2
Canvas	54.8	12.9	<u>22.0</u>	64.2	71.1	-0.5	63.4	4.74	5	975	5	5	4	2
CO13D0346	57.1	<u>11.6</u>	29.2	67.5	68.9	-0.6	<u>61.3</u>	4.96	4	935	5	5	3	4
CO15D098R	57.5	12.3	28.3	64.7	86.1	<u>-1.3</u>	<u>61.1</u>	5.02	4	1030	3	3	1	4
Crescent AX	58.2	<u>11.8</u>	31.5	<u>56.2</u>	70.5	-0.8	62.1	5.54	5	1010	6	5	3	2
Denali	52.6	13.5	25.3	<u>58.0</u>	67.7	<u>-1.1</u>	64.5	3.68	3	<u>835</u>	<u>2</u>	<u>2</u>	5	6
Guardian	59.9	<u>11.5</u>	30.9	64.2	70.8	<u>-1.2</u>	<u>61.3</u>	3.79	3	975	4	3	1	5
Long Branch	55.9	<u>12.0</u>	27.5	69.8	67.6	-0.8	62.2	3.66	4	880	4	4	5	5
Monarch	<u>52.3</u>	13.0	24.3	66.3	67.4	-0.6	63.3	6.11	5	925	3	3	5	3
Snowmass 2.0	54.4	13.9	27.6	65.4	68.2	-1.0	65.4	8.49	6	1045	5	6	3	1
Sunshine	53.9	12.8	26.3	<u>59.1</u>	69.1	<u>-1.1</u>	62.5	4.69	4	<u>855</u>	3	<u>1</u>	5	6
SY Sunrise	53.4	12.8	27.0	<u>58.7</u>	67.0	-0.2	65.1	3.66	3	<u>835</u>	<u>2</u>	<u>2</u>	5	6
SY Wolf	54.1	14.1	27.0	63.1	68.6	<u>-1.1</u>	62.4	5.42	4	960	<u>2</u>	<u>2</u>	4	5
SY Wolverine	57.0	12.6	29.1	62.5	69.1	-0.4	63.1	5.06	<u>2</u>	910	3	<u>2</u>	2	5
Thunder CL	54.0	12.6	27.2	66.6	68.2	-0.6	65.2	6.00	4	1035	5	4	4	1
WB-Grainfield	54.7	14.1	25.8	66.0	67.4	-0.9	64.3	4.12	4	900	3	3	3	4
WB4269	53.5	12.9	<u>22.7</u>	62.9	67.1	-0.3	64.3	4.10	3	1050	5	5	5	2
WB4303	<u>50.6</u>	14.5	26.0	63.7	67.2	-0.8	65.3	3.66	4	940	3	3	5	4
WB4418	<u>52.1</u>	13.8	<u>22.3</u>	<u>80.5</u>	<u>65.1</u>	-0.7	65.2	4.37	4	935	4	3	<u>8</u>	3
WB4595	58.4	12.2	25.6	75.9	68.1	-0.9	62.2	<u>3.26</u>	3	<u>825</u>	3	<u>2</u>	4	<u>7</u>
WB4699	<u>51.5</u>	13.1	<u>22.1</u>	66.3	67.6	-0.8	<u>61.3</u>	<u>3.23</u>	<u>1</u>	<u>815</u>	<u>2</u>	<u>1</u>	6	<u>9</u>
WB4792	56.5	<u>12.1</u>	25.0	75.0	68.2	-0.5	62.2	4.09	3	<u>850</u>	4	3	5	5

Average	54.9	12.9	26.4	65.6	69.0	-0.8	63.5	4.66	3.8	936	3.8	3.3		
Minimum	50.6	11.5	22.0	56.2	65.1	-1.3	61.1	3.23	1	815	2	1		
Maximum	59.9	14.5	31.5	80.5	86.1	-0.2	66.2	8.49	6	1050	6	6		

Wheat Milling and Baking Quality Data - 2019 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
AM Eastwood	61.4	13.7	33.3	74.6	67.3	-0.8	62.2	2.67	<u>1</u>	880	5	3	3	5
Brawl CL Plus	61.0	13.8	32.2	76.3	66.9	-0.6	62.0	2.42	<u>0</u>	1055	4	<u>2</u>	3	5
Breck	62.7	13.5	33.1	77.8	67.9	-1.1	62.0	3.21	<u>1</u>	1015	6	5	2	3
Canvas	62.6	13.1	30.7	79.9	69.6	-1.1	62.2	3.84	4	960	4	4	2	2
CO13D0346	<u>60.1</u>	13.2	31.1	<u>85.4</u>	<u>64.5</u>	-1.3	63.3	2.98	3	915	4	3	<u>7</u>	3
CO15D098R	61.3	12.8	32.4	<u>79.7</u>	68.2	-0.8	62.1	3.58	<u>2</u>	1020	4	4	3	3
Crescent AX	60.6	12.8	32.6	71.7	70.5	-0.7	62.9	3.92	3	1105	5	4	4	1
Denali	62.2	12.8	32.5	75.5	67.4	-1.3	60.3	2.67	<u>1</u>	795	<u>2</u>	<u>1</u>	3	<u>7</u>
Guardian	61.6	12.5	30.7	<u>83.8</u>	68.7	-0.9	61.0	3.31	<u>2</u>	920	5	3	4	4
Long Branch	60.3	13.0	32.7	<u>80.6</u>	<u>64.8</u>	-1.0	<u>59.1</u>	<u>1.93</u>	<u>0</u>	800	4	3	5	<u>8</u>
Monarch	60.9	<u>11.9</u>	30.9	<u>82.9</u>	67.2	-1.2	60.2	3.77	3	885	5	3	5	3
Snowmass 2.0	60.4	13.1	34.5	<u>83.6</u>	67.0	-1.2	64.9	4.81	5	1030	5	5	4	1
Sunshine	61.2	13.2	33.3	<u>73.1</u>	68.7	<u>-1.5</u>	<u>59.1</u>	2.53	<u>0</u>	830	4	3	4	<u>7</u>
SY Sunrise	61.8	13.4	35.6	68.7	68.9	-1.0	61.1	<u>1.79</u>	<u>0</u>	795	5	3	3	<u>7</u>
SY Wolf	61.2	13.5	32.0	<u>80.5</u>	66.1	<u>-1.8</u>	61.4	3.38	<u>2</u>	895	4	3	5	4
SY Wolverine	61.5	13.8	32.7	<u>76.8</u>	67.2	-0.6	61.1	2.68	<u>0</u>	945	4	3	3	6
Thunder CL	60.7	13.4	32.3	77.4	68.3	-1.1	62.4	3.33	<u>2</u>	1025	4	4	3	3
WB-Grainfield	61.9	13.7	35.2	79.7	67.8	-1.2	61.1	2.14	<u>0</u>	825	3	<u>2</u>	2	<u>7</u>
WB4269	60.3	<u>11.9</u>	<u>28.5</u>	75.1	<u>62.7</u>	-0.6	<u>58.2</u>	2.38	<u>0</u>	<u>675</u>	<u>2</u>	<u>2</u>	<u>7</u>	<u>9</u>
WB4303	<u>59.7</u>	13.1	34.7	73.5	67.5	-0.7	60.3	2.41	<u>0</u>	885	4	<u>2</u>	5	<u>7</u>
WB4418	<u>60.1</u>	<u>12.3</u>	<u>27.4</u>	<u>87.6</u>	<u>62.2</u>	0.2	60.2	2.60	<u>0</u>	905	3	4	<u>8</u>	6
WB4595	63.0	<u>12.1</u>	32.4	<u>89.7</u>	66.1	-1.2	<u>58.1</u>	2.24	<u>0</u>	<u>690</u>	<u>2</u>	<u>2</u>	4	<u>9</u>
WB4699	<u>59.4</u>	12.4	<u>24.0</u>	<u>82.9</u>	67.1	-1.1	<u>57.3</u>	<u>2.08</u>	<u>0</u>	800	3	<u>1</u>	<u>8</u>	<u>9</u>
WB4792	62.7	12.4	32.8	<u>85.3</u>	67.9	-1.0	59.8	2.31	<u>0</u>	<u>745</u>	3	3	3	<u>8</u>

Average	61.2	13.0	32.0	79.3	67.1	-1.0	60.9	2.87	1.2	891	3.9	3.0		
Minimum	59.4	11.9	24.0	68.7	62.2	-1.8	57.3	1.79	0	675	2	1		
Maximum	63.0	13.8	35.6	89.7	70.5	0.2	64.9	4.81	5	1105	6	5		

Summary of composite milling and baking quality scores from two 2019 Irrigated Variety Trial (IVPT) locations. Entries are ranked in ascending order (from 1=good to 9=poor) by the average baking quality score across both trial locations.

Entry	Baking Quality Scores			Milling Quality Scores		
	Burlington	Fort Collins	Average	Burlington	Fort Collins	Average
Snowmass 2.0	1	1	1.0	3	4	3.5
Crescent AX	2	1	1.5	3	4	3.5
Thunder CL	1	3	2.0	4	3	3.5
Canvas	2	2	2.0	4	2	3.0
Breck	2	3	2.5	3	2	2.5
Brawl CL Plus	1	5	3.0	2	3	2.5
Monarch	3	3	3.0	5	5	5.0
CO13D0346	4	3	3.5	3	7	5.0
CO15D098R	4	3	3.5	1	3	2.0
AM Eastwood	3	5	4.0	6	3	4.5
WB4418	3	6	4.5	8	8	8.0
Guardian	5	4	4.5	1	4	2.5
SY Wolf	5	4	4.5	4	5	4.5
WB4269	2	9	5.5	5	7	6.0
WB-Grainfield	4	7	5.5	3	2	2.5
WB4303	4	7	5.5	5	5	5.0
SY Wolverine	5	6	5.5	2	3	2.5
Long Branch	5	8	6.5	5	5	5.0
WB4792	5	8	6.5	5	3	4.0
Denali	6	7	6.5	5	3	4.0
Sunshine	6	7	6.5	5	4	4.5
SY Sunrise	6	7	6.5	5	3	4.0
WB4595	7	9	8.0	4	4	4.0
WB4699	9	9	9.0	6	8	7.0

Grain protein values (12% moisture basis) of Irrigated Variety Performance Trial (IVPT, left) and Uniform Variety Performance Trial (UVPT, right) locations that were not used for complete milling and baking quality analyses. Data for the UVPT entries represent the average of the first two replications.

IVPT Entry	Haxtun	UVPT Entry	Arapahoe	Genoa	Julesburg	Lamar	Orchard	Roggen	Sheridan Lake
AM Eastwood	13.5	AM Eastwood	8.8	9.9	10.0	11.2	12.8	9.4	11.4
Brawl CL Plus	14.0	Antero	8.5	9.6	10.5	10.6	12.3	9.0	9.7
Breck	12.5	Avery	7.9	10.4	10.0	10.3	12.5	9.0	9.6
Canvas	12.5	Brawl CL Plus	10.6	11.0	10.8	13.4	12.9	10.8	11.7
CO13D0346	12.2	Breck	9.1	11.1	10.4	10.8	12.4	9.9	10.0
CO15D098R	12.1	Byrd	8.3	11.1	10.2	11.0	13.0	9.6	9.4
Crescent AX	12.7	Byrd CL Plus	8.4	9.8	9.6	9.3	12.8	9.9	10.2
Denali	11.8	Canvas	8.9	10.4	10.0	10.1	12.3	9.7	9.8
Guardian	13.5	CO13D0346	9.0	10.6	9.8	11.5	12.9	9.7	9.2
Long Branch	13.2	CO13D1479	8.4	10.4	9.6	10.7	13.0	9.8	9.5
Monarch	12.2	CO15D098R	8.6	9.8	9.8	10.6	12.7	8.8	10.3
Snowmass 2.0	12.8	CO155FD092	8.6	10.1	10.2	11.8	12.1	9.2	11.8
Sunshine	12.9	Crescent AX	8.5	10.1	9.9	11.2	11.9	9.3	10.1
SY Sunrise	12.9	Denali	9.6	9.9	10.2	10.0	12.6	9.9	9.6
SY Wolf	12.8	Fortify SF	9.6	9.8	9.9	11.1	12.1	9.0	11.0
SY Wolverine	13.0	Guardian	8.5	11.1	10.5	9.9	12.8	9.4	9.4
Thunder CL	12.8	Hatcher	9.2	10.1	11.2	10.7	12.3	9.7	10.1
WB-Grainfield	12.6	Incline AX	9.0	10.2	10.0	9.7	12.3	9.0	10.0
WB4269	12.2	Langin	8.3	10.1	10.0	10.2	12.0	9.4	8.7
WB4303	12.8	LCH15ACC-7-7	8.7	10.9	10.8	12.1	12.3	9.7	10.1
WB4418	12.6	LCS Valliant	9.1	11.1	10.4	13.2	12.9	10.3	11.1
WB4595	12.4	Long Branch	8.0	10.2	10.5	11.2	12.5	8.6	10.4
WB4699	12.2	Monarch	8.0	10.4	9.7	9.8	12.5	9.5	9.5
WB4792	12.0	Snowmass	7.7	8.4	10.4	9.8	12.7	9.0	9.1
		Snowmass 2.0	8.2	10.6	10.4	10.3	12.4	9.3	9.4
		Spur	9.6	10.6	10.4	11.0	13.0	9.4	12.4
		Sunshine	8.5	9.8	9.9	10.3	12.0	9.5	9.8
		SY Legend CL2	9.2	11.2	10.7	11.6	13.2	11.3	10.6
		SY Monument	9.5	10.7	10.3	10.2	12.4	10.1	10.6
		SY Rugged	8.9	10.6	11.3	11.3	12.6	9.0	9.7
		SY Wolf	9.7	10.1	10.3	10.8	13.4	9.5	10.5
		SY Wolverine	8.4	10.7	10.5	11.2	12.7	10.1	10.1
		WB-Grainfield	8.8	11.4	10.3	12.0	12.9	9.1	9.8
		WB4418	9.5	9.9	11.4	11.8	12.4	9.7	9.7
		WB4462	8.7	9.9	10.5	11.2	12.3	9.0	11.0
		WB4595	8.7	10.3	10.5	10.6	12.5	8.4	8.9
		WB4792	8.8	9.4	10.1	10.2	12.6	8.5	9.4
		Whistler	8.1	10.3	9.3	9.2	12.2	9.4	9.1