

Wheat Quality Evaluations from the 2019 CSU Dryland and Irrigated Variety Trials

John Stromberger, CSU Wheat Quality Lab Manager
Scott Haley, CSU Wheat Breeder
Jerry Johnson, CSU Extension Agronomist

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 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 | | |

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 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 | | |