# RESULTS OF AGRONOMIC AND WEED SCIENCE RESEARCH CONDUCTED IN SOUTH CENTRAL MONTANA - 2020

ANNUAL REPORT OF THE INVESTIGATIONS AT AND ADMINISTRATION OF THE
SOUTHERN AGRICULTURAL RESEARCH CENTER, HUNTLEY, MONTANA

SARC Website

**PROJECT TITLE:** Off-Station Spring Barley Variety Performance Trials in South Central Montana. *This research is partially supported by the Montana Barley and Barley Committee.*

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**OBJECTIVES:** To provide growers in south central Montana with a reliable, unbiased, up-to-date source of information that will permit valid comparisons among improved spring barley varieties. This information should help spring barley producers in south central Montana select varieties best suited to their particular area and growing conditions.

**METHODS:** The 2020 off-station spring barley trials were conducted under dryland conditions at Huntley, and Broadview and under irrigation near Fromberg and Hysham Montana (Fig. 1). Twenty-five spring barley entries comprised of 20 commercial cultivars and 5 experimental lines, representing both feed and malt types, were grown at all locations.

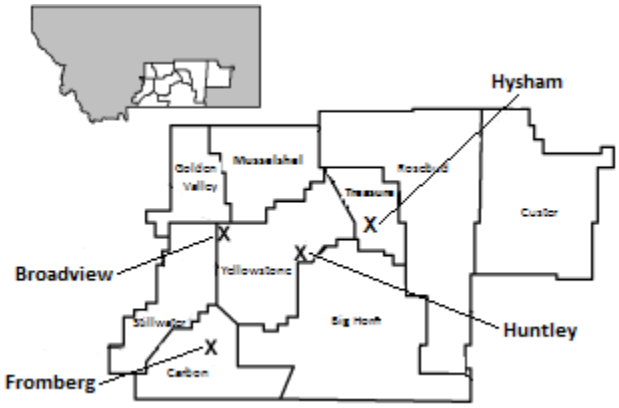


**Figure 1. 2020 off-station spring barley trial locations in south central Montana.**

All studies were planted using a partially-balanced lattice design with three replications. All entries were seeded at approximately 0.6 million seeds per acre (~14 seed per foot$^2$) under dryland conditions and 1.0 million seeds per acre (~24 seed per foot$^2$) under irrigation.

Dryland test plots consisted of a 16-foot, 4-row plot with 12-inch row spacing, while irrigated plots were 16-foot, 7-row with 7-inch row spacing. All rows of each test plot were trimmed 36 inches and harvested using an experimental-plot combine. Recorded grain yields were adjusted to 13% grain moisture content, and are reported in bushels per acre based on a 48 pound standard bushel weight. Test weight (lb/bu, pounds per bushel) and grain moisture content (%, percent) were obtained for each plot using a Dickey-John™ GAC 2100 grain analyzer. Grain protein (%, percent) was estimated using near infrared spectroscopy and is reported on a 12% moisture basis. Plant height was measured in inches from the soil surface to the top of the head, excluding the awns if present. Lodging severity, where observed, was recorded on a 0 to 9 scale representing no lodging (0) to all stems lying flat on the ground (9). Percent plump and thin kernels were determined by measuring the amount of a ~100 gram sub-sample retained above a 6-64" slotted screen and passing through a 5½-64" slotted screen, respectively, following 30 oscillations on a Strand™ sizer shaker.

**RESULTS:**

The 2020 spring barley test sites had below average rain or snow accumulation during winter months except in November. Below average precipitation was observed throughout the 2020 barley growing season except in June. The precipitation during the months of March and April provided enough moisture for spring barley emergence and early stand establishment. Higher than normal rainfall in June (4.75 inches) provided much of the needed moisture during grain filling period and boosted barley yield. This however delayed the spring barley maturity at dryland sites. A heavy grasshopper infestation was observed during 2020 growing season in south central Montana that significantly affected barley yield at some test locations.

The dryland spring barley yield at Huntley averaged 77 bu/a in 2020 (Table 1). Yield ranged from 41 bu/a for 'Expedition' to 117 bu/a for 'Hays'. Two other entries with yields ranging from 91 to 98 bu/a were statistically equal to the highest yielding cultivar. Lower yield for some entries was due to clipped heads from grasshopper feeding. Test weight averaged 51.5 lb/bu and all entries had test weight greater than 48 lb/bu. Grain protein content averaged 13.7 percent and ranged from 11.9 percent to 15.2 percent. The average yield over the past two- (2018 and 2020) and three-year (2017-2018 and 2020) for barley cultivars tested at Huntley under dryland condition was 85 and 94 bu/a respectively.

Dryland spring barley yield at Broadview averaged 30 bu/a (Table 2) which was less than half the amount of last year's yield at this site. The lower yield was mainly attributed to severe grasshopper infestation that defoliated some plants and clipped heads in the most severe instances. This year Broadview had the lowest barley yield among all location. The cultivar 'Ellinore' produced the highest yield of 59 bu/a. Test weight averaged 51.8 lb/bu and all entries except 'MT16M01801'and 'MT16M01902' had test weight greater than 48 lb/bu. Grain protein content averaged 8.8 percent. The percentage of plump kernels was 93 percent in the harvested grain. Percentage of thin kernels averaged 1.4 percent. Two (2019-2020) and three-years (2018-2020) average yield for barley cultivars tested at Broadview under dryland condition was 60 and 54 bu/a respectively.

A higher level of lodging was observed for barley cultivars at Fromberg in 2020 averaging a score of 5.9. Lodging scores ranged from 2.3 for 'ABI Voyage' to over 8 for 'Hays', 'CDC Copeland' and 'Balster' (Table 3). Spring barley yield averaged 124 bu/a under irrigation. Yield was highest at Fromberg among all locations tested in 2020. Yield ranged from 95 bu/a for 'CDC Copeland' to 152 bu/a for 'Odyssey'. Nine other barley entries produced yield statistically equal to the highest yielding cultivar. Test weight averaged 50.1 lb/bu and ranged from 45.2 lb/bu to 53.2 lb/bu. Grain protein averaged 13.1 percent ranging from a low of 11.5 for 'Buzz', an MSU variety released for its ability to maintain the lower protein desired by malting companies, to 15.2 for 'Hays', a popular feed barley. The percentage of plump kernels averaged 85

percent in the harvested grain. Percentage of thin kernels averaged 5.3 percent. The average yield for barley cultivars tested over the past Two (2019-2020) and three-year (2018-2020) was 126 and 121 bu/a respectively. The cultivar 'Odyssey' was the top yielding cultivar over the past two and three-years with an average yield of 153 and 141 bu/a respectively.

Spring barley lodging was moderately high for some cultivars at Hysham in 2020 with an average lodging score of 3.3 out of 9. Lodging score ranged from 0.7 for 'Growler'' and 'Genie' to 6.7 for 'Haxby' (Table 4). Spring barley yield under irrigation at Hysham averaged 115 bu/a. Yield ranged from 71 bu/a for 'Buzz' to 156 bu/a for 'Diablo'. Six other cultivars also produced grain yield that was statistically equal to the yield of 'Diablo'. Average test weight was 50.5 lb/bu and ranged from 46.4 to 53.2 lb/bu. Grain protein content averaged 12.3 percent and ranged from 11.0 to 13.7 percent. Barley quality was good at Hysham where mean percent plump and thin kernels were 87 and 5.2 percent, respectively. Two and three years averaged yield for barley cultivars tested during 2018 to 2020 at Hysham was 117 and 118 bu/a respectively.

**SUMMARY:**

Below-average precipitation was observed throughout the 2020 barley growing season except in June. High rainfall in June (4.75 inches) provided much of the needed moisture during grain filling period and boosted spring barley yield at most of the dryland test locations. Severe grasshopper infestation was observed this year particularly at Broadview and Huntley. Both locations suffered heavy yield loss that varied among the cultivars. Averaged across all locations, Odyssey was the top yielding cultivar producing 107 bu/a followed by Diablo. (Table 5). Odyssey also had the highest yield under irrigated condition (148 bu/a), while Hays produced the highest yield under dryland condition (81 bu/a) (Tables 5 and 8)). The two and three-years average grain yield was 98 and 96 bu/a respectively (Table 6). Genie was the highest yielding cultivar averaged across all test sites for 2018-2020 (Table 6) while Odyssey was the highest yielding cultivar averaged over the 3 irrigated locations (Table 7). Averaged across all locations grain protein content was 12.1 percent. Overall test weight averaged 51.1 lb/bu while percent plump averaged 89 (Table 6), and was slightly higher, 86 under irrigation (Table 7).

Table 1. Performance of 25 spring barley cultivars and experimental lines tested under dryland conditions near Huntley, Montana during 2020. Yield is expressed as bu/a; test weight as lbs/a; moisture, protein, plump, and thin as %; height as inches. (Exp. 203690).

| Cultivar | Yield[1] 2020 | Yield 2018-20 | Yield 2017-20 | Test Weight | Grain Moisture | Grain[2] Protein | Plant Height | Heading Date |
|---|---|---|---|---|---|---|---|---|
| Commercial | | | | | | | | |
| Opera | 71.5 | - | - | 50.8 | 10.4 | 13.1 | 28.3 | Jun-28 |
| Odyssey | 78.5 | 82.5 | 93.2 | 50.8 | 10.5 | 13.6 | 29.0 | Jun-28 |
| AC Metcalfe | 78.8 | 83.9 | 94.4 | 52.8 | 11.0 | 14.7 | 35.6 | Jun-16 |
| Merit 57 | 43.3 | 70.8 | 86.4 | 50.8 | 10.7 | 14.7 | 31.5 | Jun-22 |
| Leandra | 92.6 | - | - | 50.3 | 10.3 | 13.8 | 30.2 | Jun-27 |
| Lavina | **98.7** | 90.9 | 97.3 | 49.0 | 10.9 | 14.5 | 37.6 | Jun-17 |
| Hockett | 53.1 | 76.3 | 86.7 | 53.4 | 11.1 | 13.0 | 32.4 | Jun-19 |
| Hays | **117.3** | 101.2 | 104.8 | 49.1 | 10.9 | 14.5 | 35.5 | Jun-18 |
| Haxby | 83.7 | 80.8 | 93.4 | 54.0 | 10.9 | 14.5 | 32.2 | Jun-18 |
| Growler | 68.6 | 77.8 | 89.0 | 51.1 | 11.0 | 15.2 | 33.6 | Jun-21 |
| Genie | 92.7 | 95.6 | 101.7 | 52.5 | 10.7 | 13.5 | 31.5 | Jun-26 |
| Expedition | 41.0 | - | - | 52.6 | 10.7 | 13.7 | 28.9 | Jun-26 |
| Ellinore | 55.6 | - | - | 48.8 | 10.7 | 13.4 | 28.0 | Jun-26 |
| Diablo | **102.2** | - | - | 49.4 | 10.4 | 13.5 | 30.5 | Jun-27 |
| Craft | 90.3 | - | - | 53.3 | 10.8 | 14.4 | 36.1 | Jun-17 |
| CDC | | | | | | | | |
| Copeland | 88.4 | 87.8 | 95.7 | 51.7 | 11.1 | 14.7 | 38.1 | Jun-20 |
| Buzz | 68.7 | | | 52.6 | 11.1 | 11.9 | 33.4 | Jun-13 |
| Balster | 87.9 | 89.4 | 98.9 | 51.5 | 10.8 | 14.4 | 35.4 | Jun-19 |
| ABI Voyager | 53.9 | - | - | 51.2 | 11.1 | 14.5 | 35.9 | Jun-20 |
| AAC Synergy | 85.8 | - | - | 51.8 | 10.5 | 14.0 | 37.1 | Jun-18 |
| Experimental | | | | | | | | |
| MT16M05610 | 68.0 | - | - | 52.0 | 10.9 | 12.7 | 34.8 | 21-Jun |
| MT16M01902 | 93.9 | - | - | 51.2 | 10.9 | 12.6 | 32.9 | 11-Jun |
| MT16M01801 | 63.5 | - | - | 51.6 | 10.9 | 11.9 | 34.7 | 19-Jun |
| MT16M01405 | 75.6 | - | - | 52.7 | 11.0 | 12.7 | 33.5 | 12-Jun |
| MT16M00406 | 80.9 | - | - | 51.2 | 10.9 | 12.4 | 36.2 | 18-Jun |
| Average | 77.4 | 85.2 | 94.7 | 51.5 | 10.8 | 13.7 | 33.3 | 172.6[3] |
| LSD (p=0.05) | 21.6 | ns | ns | 0.8 | 0.3 | 0.4 | 2.9 | 2.8 |
| CV% | 15.5 | 13.1 | 10.0 | 0.9 | 1.7 | 2.0 | 5.0 | 0.9 |
| Lattice RE% | 143 | 100 | 100 | 101 | 114 | 100 | 111 | 104 |

1/ Yields are based on a 48 pound standard bushel weight and adjusted to 13.0 percent moisture content. Two and Three years average based on 2017, 2018, and 2020.
2/ Grain protein values adjusted to 12% moisture basis.
3/ Mean heading date is number of calendar days in the year.
**Bold** Indicates highest yielding cultivar within a column.
**Bold** Indicates cultivars yielding equal to highest yielding cultivar within a column based on Fisher's protected LSD (p=0.05).
ns Indicates no significant difference between cultivars within a column based on Fisher's protected LSD (p=0.05).

Huntley Dryland Spring Barley (Exp. 203690)

| | |
|---|---|
| Planted: | March 11, 2020 |
| Harvested: | July 24, 2020 |
| Fertility: | Fall soil test 86-20-701 lbs/a NPK; 82 lb/a N in spring 2020 broadcast as urea |
| Herbicide: | n/a |
| Previous | Crop: Fallow |
| Precipitation: | 9.1 in |

Table 2. Performance of 25 spring barley cultivars and experimental lines tested under dryland conditions near Broadview, Montana. Yield is expressed as bu/a; test weight as lbs/a; moisture, protein, plump, and thin as %; height as inches. (Exp. 203692).

| Cultivar | Yield[1] 2020 | Yield 2019-20 | Yield 2018-20 | Test Weight | Grain Moisture | Grain[2] Protein | Plump Kernels | Thin Kernels | Plant Height |
|---|---|---|---|---|---|---|---|---|---|
| Commercial | | | | | | | | | |
| Opera | 36.9 | 58.0 | - | 52.7 | 9.9 | 8.1 | 95.5 | 1.4 | 24.2 |
| Odyssey | 43.5 | 64.7 | 60.8 | 52.9 | 10.0 | 8.3 | 96.9 | 1.1 | 23.9 |
| AC Metcalfe | 30.3 | 54.0 | 46.6 | 54.0 | 9.9 | 9.8 | 97.3 | 0.8 | 30.1 |
| Merit 57 | 30.2 | 50.3 | 45.0 | 52.6 | 9.9 | 8.9 | 93.6 | 1.7 | 28.4 |
| Leandra | **50.7** | - | - | 51.9 | 9.8 | 9.0 | 98.3 | 0.6 | 22.2 |
| Lavina | 37.0 | 53.7 | 50.2 | 51.4 | 9.9 | 9.7 | 88.2 | 3.5 | 29.4 |
| Hockett | 22.6 | 56.4 | 51.4 | 54.7 | 10.1 | 9.3 | 97.6 | 1.2 | 28.6 |
| Hays | **49.6** | 63.8 | 55.4 | 51.5 | 9.9 | 9.5 | 91.9 | 2.7 | 27.1 |
| Haxby | 26.9 | 55.9 | 51.1 | 55.3 | 9.9 | 9.1 | 95.5 | 1.0 | 26.9 |
| Growler | 33.4 | 64.8 | 55.3 | 51.9 | 10.0 | 9.2 | 91.8 | 2.5 | 28.0 |
| Genie | 36.5 | 76.6 | 67.6 | 53.5 | 9.9 | 8.8 | 95.7 | 2.0 | 26.4 |
| Expedition | 35.8 | 66.1 | - | 54.1 | 10.1 | 9.6 | 96.7 | 1.4 | 24.4 |
| Ellinore | **59.1** | - | - | 50.7 | 9.7 | 8.2 | 92.4 | 2.1 | 23.6 |
| Diablo | 40.6 | - | - | 50.7 | 9.9 | 8.1 | 95.7 | 1.3 | 23.7 |
| Craft | 21.4 | 51.4 | - | 54.8 | 9.6 | 10.8 | 96.9 | 1.0 | 32.8 |
| CDC Copeland | 40.5 | 64.6 | 58.9 | 54.0 | 9.7 | 10.7 | 97.6 | 1.0 | 31.3 |
| Buzz | 9.4 | - | - | 54.5 | 10.5 | 9.2 | 96.9 | 0.8 | 25.7 |
| Balster | 20.8 | 53.5 | 48.2 | 51.9 | 10.0 | 9.4 | 91.5 | 2.1 | 29.6 |
| ABI Voyager | 15.7 | - | - | 53.1 | 10.2 | 10.4 | 96.1 | 1.4 | 31.5 |
| AAC Synergy | 36.2 | - | - | 51.9 | 9.3 | 9.8 | 96.6 | 1.1 | 29.2 |
| Experimental | | | | | | | | | |
| MT16M05610 | 19.3 | - | - | 52.9 | 10.0 | 9.7 | 96.5 | 1.4 | 27.6 |
| MT16M01902 | 6.6 | - | - | 32.1 | 10.0 | 3.0 | 31.3 | 0.6 | 27.1 |
| MT16M01801 | 19.4 | - | - | 47.2 | 9.9 | 5.5 | 96.5 | 1.1 | 29.2 |
| MT16M01405 | 13.8 | - | - | 51.7 | 10.0 | 6.3 | 97.2 | 1.0 | 27.2 |
| MT16M00406 | 17.6 | - | - | 53.6 | 9.7 | 8.8 | 97.2 | 1.1 | 29.6 |
| Average | 30.2 | 59.6 | 53.7 | 51.8 | 9.9 | 8.8 | 92.9 | 1.4 | 27.5 |
| LSD (p=0.05) | 11.3 | ns | ns | 1.7 | 0.3 | 0.6 | 2.0 | 0.7 | 2.5 |
| CV% | 21.4 | 13.4 | 11.9 | 2.1 | 2.0 | 3.5 | 1.3 | 27.3 | 5.2 |
| Lattice RE% | 110 | 100 | 100 | 100 | 102 | 140 | 102 | 106 | - |

1/ Grain yields are based on a 48 pound standard bushel weight and adjusted to 13.0 percent moisture content.
2/ Grain protein values adjusted to 12% moisture basis.
**Bold** Indicates highest yielding cultivar within a column.
**Bold** Indicates cultivars yielding equal to highest yielding cultivar within a column based on Fisher's protected LSD (p=0.05).
ns Indicates no significant difference between cultivars within a column based on Fisher's protected LSD (p=0.05).

| Broadview Dryland Spring Barley (Exp. 203692) | |
|---|---|
| Planted: | March 11, 2020 |
| Harvested: | August 5, 2020 |
| Fertility: | 30-0-0-5 NPKS 5/12/2020 as 28% UAN + S |
| Herbicide: | n/a |
| Previous Crop: | Chickpea |
| Precipitation: | n/a |

Table 3. Performance of 25 spring barley cultivars and experimental lines tested under irrigated conditions near Fromberg, Montana during 2020. Yield is expressed as bu/a; test weight as lbs/a; moisture, protein, plump, and thin as %; height as inches; Lodging as score of 0-9. (Exp. 203794).

| Cultivar | Yield[1] 2020 | Yield 2019-20 | Yield 2018-20 | Test Weight | Grain Moisture | Grain[2] Protein | Plump Kernels | Thin Kernels | Plant Height | Lodging[3] |
|---|---|---|---|---|---|---|---|---|---|---|
| Commercial | | | | | | | | | | |
| Odyssey | **151.5** | **152.6** | **141.1** | 49.5 | 10.1 | 11.7 | 93.5 | 2.1 | 32.9 | 3.6 |
| Opera | 108.0 | 113.8 | - | 45.2 | 9.7 | 12.0 | 72.4 | 10.6 | 31.5 | 6.8 |
| AC Metcalfe | 122.7 | 126.0 | **121.4** | 52.4 | 10.5 | 14.2 | 89.0 | 3.7 | 40.9 | 6.9 |
| Merit 57 | **134.5** | 125.8 | **125.4** | 50.9 | 10.3 | 12.8 | 90.4 | 1.0 | 38.5 | 6.2 |
| Leandra | 114.3 | - | - | 47.2 | 9.6 | 13.5 | 76.3 | 8.2 | 35.3 | 6.8 |
| Lavina | 121.0 | 111.4 | 94.9 | 46.2 | 10.2 | 15.3 | 53.7 | 15.5 | 43.0 | 7.3 |
| Hockett | **141.7** | 128.4 | **119.6** | 52.1 | 10.4 | 12.4 | 89.1 | 4.7 | 38.1 | 6.0 |
| Hays | 97.3 | 110.9 | 106.0 | 45.8 | 9.9 | 15.2 | 47.0 | 24.2 | 42.5 | 8.6 |
| Haxby | **132.2** | **136.8** | **130.3** | 53.2 | 10.4 | 13.8 | 91.0 | 2.3 | 39.4 | 6.4 |
| Growler | **133.0** | **133.9** | **124.3** | 50.4 | 10.3 | 13.5 | 87.7 | 5.3 | 37.9 | 5.9 |
| Genie | **130.7** | **136.1** | **130.1** | 49.0 | 10.3 | 13.0 | 79.3 | 5.5 | 34.5 | 4.0 |
| Expedition | **145.1** | **142.7** | - | 51.3 | 10.6 | 12.5 | 86.2 | 4.9 | 33.6 | 4.6 |
| Ellinore | **130.5** | - | - | 47.4 | 9.9 | 12.4 | 90.4 | 2.8 | 33.5 | 4.5 |
| Diablo | **132.1** | - | - | 45.4 | 9.7 | 12.8 | 82.0 | 7.5 | 33.3 | 6.2 |
| Craft | 110.2 | 116.5 | - | 52.0 | 10.4 | 13.8 | 89.8 | 3.4 | 39.2 | 7.8 |
| CDC Copeland | 95.4 | 105.6 | 108.2 | 50.7 | 10.0 | 14.2 | 83.8 | 7.1 | 46.7 | 8.8 |
| Buzz | 108.3 | - | - | 52.0 | 11.1 | 11.5 | 94.0 | 1.7 | 38.3 | 3.3 |
| Balster | 120.9 | 127.3 | **127.8** | 49.5 | 10.1 | 14.7 | 84.1 | 6.0 | 39.0 | 8.1 |
| ABI Voyager | 123.6 | - | - | 53.2 | 10.9 | 12.6 | 96.4 | 1.2 | 42.9 | 2.3 |
| AAC Synergy | **136.2** | - | - | 52.2 | 10.7 | 13.6 | 90.6 | 2.6 | 41.7 | 6.5 |
| Experimental | | | | | | | | | | |
| MT16M05610 | 111.8 | - | - | 51.6 | 10.5 | 12.4 | 92.8 | 2.1 | 41.3 | 7.5 |
| MT16M01902 | **145.8** | - | - | 50.3 | 10.4 | 12.6 | 94.4 | 0.5 | 40.3 | 3.0 |
| MT16M01801 | 113.5 | - | - | 52.1 | 10.8 | 11.7 | 94.2 | 2.2 | 40.8 | 6.2 |
| MT16M01405 | 117.7 | - | - | 51.8 | 10.6 | 13.4 | 91.2 | 3.2 | 38.1 | 3.9 |
| MT16M00406 | 110.0 | - | - | 51.0 | 10.8 | 12.7 | 90.4 | 3.9 | 42.5 | 6.7 |
| Average | 123.5 | 126.3 | 120.8 | 50.1 | 10.3 | 13.1 | 85.2 | 5.3 | 38.6 | 5.9 |
| LSD (p=0.05) | 24.9 | 23.6 | 22.0 | 1.7 | 0.4 | 1.1 | 7.7 | 5.2 | 3.0 | 3.5 |
| CV% | 12.3 | 9.4 | 8.4 | 2.1 | 2.7 | 4.6 | 5.1 | 56.8 | 4.7 | 34.4 |
| Lattice RE% | 101 | 100 | 100 | 101 | 101 | 147 | 125 | 107 | 101 | 108 |

1/ Yields are based on 48 pound standard bushel weight and adjusted to 13.0 percent moisture content.
2/ Grain protein values adjusted to 12% moisture basis.
3/ Lodging severity scores of 0 to 9 represent no lodging to all stems flat on the ground, respectively.
**Bold** Indicates highest yielding cultivar within a column.
**Bold** Indicates cultivars yielding equal to highest yielding cultivar within a column based on Fisher's protected LSD (p=0.05).

| Fromberg Irrigated Spring Barley (Exp. 203794) | |
|---|---|
| Planted: | March 27, 2020 |
| Harvested: | August 10, 2020 |
| Fertility: | 100-0-25-20 N-P-K-S lb/a |
| Herbicide: | n/a |
| Insecticide/Fungicide: | n/a |
| Previous Crop: | Sugar beet |
| Irrigation: | overhead sprinkler |

Table 4. Performance of 25 spring barley cultivars and experimental lines tested under irrigated conditions near Hysham, Montana during 2020. Yield is expressed as bu/a; test weight as lbs/a; moisture, protein, plump, and thin as %; height as inches; Lodging as score of 0-9. (Exp. 203795).

| Cultivar | Yield[1] 2020 | Yield 2019-20 | Yield 2018-20 | Test Weight | Grain Moisture | Grain[2] Protein | Plump Kernels | Thin Kernels | Plant Height | Lodging[3] |
|---|---|---|---|---|---|---|---|---|---|---|
| Commercial | | | | | | | | | | |
| Opera | **132.9** | 111.9 | - | 48.0 | 9.0 | 11.8 | 80.7 | 8.4 | 30.4 | 2.7 |
| Odyssey | **144.8** | 121.4 | 123.1 | 48.7 | 9.1 | 11.6 | 89.9 | 3.6 | 30.1 | 3.0 |
| AC Metcalfe | 105.5 | 105.6 | 107.9 | 53.5 | 9.6 | 13.0 | 92.1 | 2.3 | 39.9 | 3.0 |
| Merit 57 | 122.0 | 121.9 | 120.4 | 48.2 | 8.9 | 12.8 | 80.6 | 8.6 | 38.7 | 3.0 |
| Leandra | **143.6** | - | - | 49.0 | 9.2 | 11.5 | 88.4 | 3.5 | 29.1 | 3.0 |
| Lavina | 102.2 | - | - | 45.9 | 9.1 | 13.5 | 49.7 | 22.5 | 39.9 | 4.7 |
| Hockett | 109.7 | 114.5 | 116.8 | 52.6 | 9.6 | 12.8 | 92.5 | 3.1 | 36.0 | 5.0 |
| Hays | 107.8 | | | 47.1 | 8.7 | 13.4 | 57.1 | 18.2 | 39.0 | 5.7 |
| Haxby | 101.2 | 110.1 | 98.7 | 51.5 | 9.4 | 12.5 | 86.7 | 5.8 | 35.6 | 6.7 |
| Growler | **143.9** | 129.9 | 131.0 | 51.9 | 9.3 | 12.6 | 93.8 | 2.4 | 35.6 | 0.7 |
| Genie | **140.6** | 128.9 | 130.8 | 52.0 | 9.5 | 10.9 | 94.9 | 1.4 | 32.4 | 0.7 |
| Expedition | **137.8** | 127.5 | - | 51.0 | 9.5 | 12.1 | 83.5 | 6.6 | 31.9 | 1.0 |
| Ellinore | 115.6 | - | - | 46.4 | 8.8 | 11.3 | 87.0 | 4.6 | 31.9 | 3.0 |
| Diablo | **156.0** | - | - | 47.8 | 8.8 | 11.0 | 91.7 | 2.9 | 32.5 | 3.3 |
| Craft | 92.8 | 103.3 | - | 52.1 | 9.2 | 13.7 | 86.4 | 5.8 | 38.2 | 5.7 |
| CDC Copeland | 105.9 | 102.2 | 109.6 | 51.6 | 9.2 | 13.6 | 87.4 | 5.0 | 39.4 | 6.0 |
| Buzz | 70.5 | - | - | 51.7 | 9.7 | 11.5 | 92.2 | 3.0 | 36.1 | 2.7 |
| Balster | 124.2 | 120.6 | 118.8 | 51.8 | 9.4 | 12.8 | 92.5 | 2.3 | 36.7 | 2.7 |
| ABI Voyager | 108.5 | - | - | 53.2 | 9.6 | 12.5 | 94.5 | 2.2 | 39.6 | 1.0 |
| AAC Synergy | 127.7 | - | - | 52.1 | 9.5 | 12.4 | 91.3 | 3.0 | 37.3 | 3.0 |
| Experimental | | | | | | | | | | |
| MT16M05610 | 107.0 | - | - | 51.5 | 9.5 | 12.1 | 92.0 | 3.2 | 39.4 | 3.7 |
| MT16M01902 | 109.2 | - | - | 50.6 | 9.1 | 11.8 | 91.7 | 3.5 | 36.9 | 2.3 |
| MT16M01801 | 80.9 | - | - | 50.7 | 9.3 | 11.6 | 88.1 | 5.5 | 41.1 | 6.0 |
| MT16M01405 | 100.7 | - | - | 52.6 | 9.7 | 11.9 | 95.6 | 1.7 | 34.3 | 1.0 |
| MT16M00406 | 83.4 | - | - | 51.8 | 9.3 | 11.8 | 95.1 | 1.7 | 37.3 | 2.7 |
| Average | 115.0 | 116.5 | 117.5 | 50.5 | 9.3 | 12.3 | 87.0 | 5.2 | 36.0 | 3.3 |
| LSD (p=0.05) | 27.3 | ns | ns | 2.3 | 0.3 | 0.7 | 8.1 | 4.1 | 3.3 | 2.8 |
| CV% | 14.4 | 11.4 | 10.5 | 2.7 | 2.1 | 3.4 | 5.7 | 48.1 | 5.2 | 52.7 |
| Lattice RE% | 104 | 100 | 100 | 100 | 103 | 116 | 101 | 104 | 108 | 100 |

1/ Yields are based on 48 pound standard bushel weight and adjusted to 13.0 percent moisture content.
2/ Grain protein values adjusted to12 percent moisture basis.
3/ Lodging severity scores of 0 to 9 represent no lodging to all stems flat on the ground, respectively.
Note: Cultivars Haybet, Hays and Lavina were grazed/damaged by deer and were excluded from data analysis.
**Bold** Indicates highest yielding cultivar within a column.
**Bold** Indicates cultivars yielding equal to highest yielding cultivar within a column based on Fisher's protected LSD (p=0.05).
ns: Indicates no significant difference between cultivars within a column based on Fisher's protected LSD (p=0.05).

| Hysham Irrigated Spring Barley (Exp. 203795) | |
|---|---|
| Planted: | April 12, 2020 |
| Harvested: | August 17, 2020 |
| Fertility: | 130-0-0 lb/a NPK |
| Herbicide: | n/a |
| Previous | Crop: Sugar beet |
| Irrigation: | flood |

Table 5. Grain yield of 25 spring barley cultivars tested at three locations in south central Montana during 2020. Varieties listed by declining combined average yield (last column). Grain yield as bushels/acre.

| Cultivar | Dryland Huntley Yield[1] | Dryland Broadview Yield | Dryland Average Yield | Irrigated Fromberg Yield | Irrigated Hysahm Yield | Irrigated Average Yield | Overall Average Yield |
|---|---|---|---|---|---|---|---|
| Odyssey | 78.5 | 43.5 | **66.1** | **151.5** | **144.8** | **148.2** | **107.1** |
| Diablo | **102.2** | 40.6 | **69.6** | **132.1** | **156.0** | **144.0** | **106.8** |
| Leandra | 92.6 | **50.7** | **74.9** | 114.3 | **143.6** | **129.0** | **101.9** |
| Genie | 92.7 | 36.5 | **64.8** | **130.7** | **140.6** | **135.7** | **100.2** |
| AAC Synergy | 85.8 | 36.2 | **60.1** | **136.2** | 127.7 | **131.9** | **96.0** |
| Growler | 68.6 | 33.4 | 49.9 | **133.0** | **143.9** | **138.5** | **94.2** |
| Ellinore | 55.6 | **59.1** | **60.7** | **130.5** | 115.6 | **123.1** | **91.9** |
| Hays | **117.3** | **49.6** | **81.1** | 97.3 | 107.8 | 102.5 | **91.8** |
| Expedition | 41.0 | 35.8 | 40.5 | **145.1** | **137.8** | **141.5** | **91.0** |
| Opera | 71.5 | 36.9 | **58.4** | 108.0 | **132.9** | **120.4** | **89.4** |
| Lavina | **98.7** | 37.0 | **66.0** | 121.0 | 102.2 | 111.6 | **88.8** |
| Balster | 87.9 | 20.8 | 55.1 | 120.9 | 124.2 | **122.5** | **88.8** |
| MT16M01902 | 93.9 | 6.6 | 45.9 | **145.8** | 109.2 | **127.5** | **86.7** |
| Haxby | 83.7 | 26.9 | 55.0 | **132.2** | 101.2 | 116.7 | 85.9 |
| AC Metcalfe | 78.8 | 30.3 | 55.2 | 122.7 | 105.5 | 114.1 | 84.6 |
| Hockett | 53.1 | 22.6 | 40.5 | **141.7** | 109.7 | **125.7** | 83.1 |
| Merit 57 | 43.3 | 30.2 | 37.8 | **134.5** | 122.0 | **128.2** | 83.0 |
| CDC Copeland | 88.4 | 40.5 | **62.3** | 95.4 | 105.9 | 100.7 | 81.5 |
| Craft | 90.3 | 21.4 | 54.0 | 110.2 | 92.8 | 101.5 | 77.8 |
| MT16M01405 | 75.6 | 13.8 | 44.0 | 117.7 | 100.7 | 109.2 | 76.6 |
| MT16M05610 | 68.0 | 19.3 | 42.5 | 111.8 | 107.0 | 109.4 | 75.9 |
| ABI Voyager | 53.9 | 15.7 | 35.0 | 123.6 | 108.5 | 116.1 | 75.5 |
| MT16M00406 | 80.9 | 17.6 | 46.4 | 110.0 | 83.4 | 96.7 | 71.6 |
| MT16M01801 | 63.5 | 19.4 | 39.7 | 113.5 | 80.9 | 97.2 | 68.5 |
| Buzz | 68.7 | 9.4 | 38.6 | 108.3 | 70.5 | 89.4 | 64.0 |
| Average | 77.4 | 30.2 | 53.8 | 123.5 | 115.0 | 119.2 | 86.5 |
| LSD (p=0.05) | 21.6 | 11.3 | 25.6 | 24.9 | 27.3 | 28.6 | 21.1 |
| CV% | 15.5 | 21.4 | 22.6 | 12.3 | 14.4 | 13.3 | 16.4 |

1/ Yields are based on 48 pound standard bushel weight and adjusted to 13.0 percent moisture content.

**Bold** Indicates highest yielding cultivar within a column.
**Bold** Indicates cultivars yielding equal to highest yielding cultivar within a column based on Fisher's protected LSD (p=0.05).

Table 6. Performance of 25 spring barley cultivars and experimental lines tested under dryland and irrigated conditions at four locations in south central Montana during 2020. Yield is expressed as bu/a; test weight as lbs/a; moisture, protein, plump, and thin as %; height as inches;

| Cultivar | Yield[1] 2020 | Yield 2019-20 | Yield 2018-20 | Test Weight | Grain Moisture | Grain[2] Protein | Plump Kernels | Thin Kernels | Plant Height |
|---|---|---|---|---|---|---|---|---|---|
| Commercial | | | | | | | | | |
| Opera | **89.4** | 92.7 | - | 49.1 | 9.8 | 11.3 | 82.7 | 6.8 | 28.5 |
| Odyssey | **107.1** | **109.4** | **103.6** | 50.5 | 9.9 | 11.4 | 92.7 | 2.5 | 29.1 |
| AC Metcalfe | 84.6 | 93.0 | 90.5 | 53.2 | 10.3 | 13.0 | 92.3 | 2.5 | 36.7 |
| Merit 57 | 83.0 | 91.8 | 92.2 | 50.6 | 9.9 | 12.4 | 87.6 | 4.0 | 34.3 |
| Leandra | **101.9** | **-** | - | 49.6 | 9.7 | 12.0 | 87.8 | 4.1 | 29.1 |
| Lavina | **88.8** | - | - | 48.1 | 10.1 | 13.2 | 64.3 | 13.7 | 37.5 |
| Hockett | 83.1 | 94.2 | 92.3 | 53.2 | 10.3 | 11.9 | 92.7 | 3.1 | 33.9 |
| Hays | **91.8** | - | - | 48.4 | 9.9 | 13.2 | 65.3 | 15.0 | 36.1 |
| Haxby | 85.9 | **98.5** | 91.1 | 53.5 | 10.2 | 12.5 | 91.0 | 3.1 | 33.5 |
| Growler | **94.2** | **103.7** | **98.9** | 51.3 | 10.1 | 12.6 | 91.5 | 3.1 | 33.7 |
| Genie | **100.2** | **110.7** | **107.0** | 51.8 | 10.1 | 11.5 | 90.4 | 2.9 | 31.1 |
| Expedition | **91.0** | **102.7** | - | 52.3 | 10.2 | 12.0 | 88.6 | 4.5 | 29.9 |
| Ellinore | **91.9** | - | **-** | 48.1 | 9.7 | 11.4 | 89.2 | 3.3 | 29.4 |
| Diablo | **106.8** | **-** | - | 48.3 | 9.7 | 11.3 | 90.0 | 3.9 | 30.0 |
| Craft | 77.8 | 89.7 | - | 53.1 | 10.0 | 13.2 | 90.9 | 3.4 | 36.5 |
| CDC Copeland | 81.5 | 89.8 | 91.5 | 52.0 | 10.0 | 13.3 | 89.7 | 4.2 | 38.7 |
| Buzz | 64.0 | - | - | 52.7 | 10.6 | 11.0 | 94.7 | 1.9 | 33.2 |
| Balster | **88.8** | **98.7** | 96.6 | 51.2 | 10.1 | 12.8 | 89.4 | 3.5 | 35.2 |
| ABI Voyager | 75.5 | - | - | 52.7 | 10.5 | 12.6 | 94.8 | 1.9 | 37.6 |
| AAC Synergy | **96.0** | - | - | 52.0 | 10.0 | 12.3 | 93.8 | 2.0 | 36.2 |
| | | | | | | | | | |
| Experimental | | | | | | | | | |
| MT16M05610 | 75.9 | - | - | 52.0 | 10.2 | 11.7 | 93.7 | 2.3 | 35.8 |
| MT16M01902 | **86.7** | - | - | 49.1 | 10.1 | 11.6 | 92.0 | 2.1 | 34.3 |
| MT16M01801 | 68.5 | - | - | 51.6 | 10.2 | 10.9 | 93.1 | 2.8 | 36.4 |
| MT16M01405 | 76.6 | - | - | 52.2 | 10.3 | 11.7 | 95.4 | 1.7 | 33.2 |
| MT16M00406 | 71.6 | - | - | 51.9 | 10.1 | 11.4 | 94.6 | 2.0 | 36.4 |
| Average | 86.5 | 97.9 | 96.0 | 51.1 | 10.1 | 12.1 | 89.1 | 4.0 | 33.9 |
| PLSD (p=0.05) | 21.1 | 13.3 | 9.9 | 1.9 | 0.3 | 0.7 | 10.5 | 5.0 | 1.8 |
| CV% | 16.4 | 12.3 | 10.9 | 2.1 | 2.1 | 4.3 | 4.7 | 59.6 | 5.4 |
| Location x Year | 4 | 7 | 11 | 4 | 4 | 4 | 4 | 4 | 4 |

1/ Yields are based on 48 pound standard bushel weight and adjusted to 13.0 percent moisture content.
2/ Grain protein values adjusted to 12% moisture basis.
**Bold** Indicates highest yielding cultivar within a column.
**Bold** Indicates cultivars yielding equal to highest yielding cultivar within a column based on Fisher's protected LSD (p=0.05).

Table 7. Performance of 25 spring barley cultivars and experimental lines tested under irrigated conditions at two locations in south central Montana during 2020. Yield is expressed as bu/a; test weight as lbs/a; moisture, protein, plump, and thin as %; height as inches; Lodging as score of 0-9.

| Cultivar | Yield[1] 2020 | Yield 2019-20 | Yield 2018-20 | Test Weight | Grain Moist | Grain[2] Protein | Plump Kernels | Thin Kernels | Plant Height | Lodg-ing |
|---|---|---|---|---|---|---|---|---|---|---|
| Commercial | | | | | | | | | | |
| Opera | **120.4** | 112.8 | - | 46.6 | 9.3 | 12.0 | 76.4 | 9.5 | 31.0 | 4.8 |
| Odyssey | **148.2** | **137.0** | **132.1** | 49.1 | 9.6 | 11.8 | 90.6 | 3.2 | 31.5 | 3.7 |
| AC Metcalfe | 114.1 | 115.8 | 114.6 | 53.0 | 10.0 | 13.7 | 89.8 | 3.2 | 40.4 | 5.0 |
| Merit 57 | **128.2** | **123.8** | **122.9** | 49.6 | 9.6 | 13.0 | 84.6 | 5.1 | 38.6 | 4.8 |
| Leandra | **129.0** | - | - | 48.1 | 9.4 | 12.5 | 82.9 | 5.6 | 32.2 | 4.7 |
| Lavina | 111.6 | - | - | 46.0 | 9.7 | 14.4 | 52.4 | 18.9 | 41.5 | 5.8 |
| Hockett | **125.7** | **121.5** | **118.2** | 52.4 | 10.0 | 12.7 | 90.2 | 4.1 | 37.0 | 5.8 |
| Hays | 102.5 | - | - | 46.4 | 9.3 | 14.3 | 52.0 | 21.2 | 40.7 | 7.0 |
| Haxby | 116.7 | **123.5** | 114.5 | 52.3 | 9.9 | 13.2 | 88.7 | 4.2 | 37.5 | 6.5 |
| Growler | **138.5** | **131.9** | **127.6** | 51.2 | 9.8 | 12.9 | 91.4 | 3.5 | 36.7 | 3.2 |
| Genie | **135.7** | **132.5** | **130.4** | 50.5 | 9.9 | 11.9 | 87.7 | 3.3 | 33.5 | 2.2 |
| Expedition | **141.5** | **135.1** | **-** | 51.2 | 10.0 | 12.3 | 84.5 | 6.0 | 32.7 | 3.0 |
| Ellinore | **123.1** | **-** | **-** | 46.9 | 9.3 | 12.0 | 88.0 | 3.9 | 32.7 | 3.8 |
| Diablo | **144.0** | **-** | **-** | 46.6 | 9.2 | 11.8 | 87.2 | 5.1 | 32.9 | 4.7 |
| Craft | 101.5 | 109.9 | **-** | 52.1 | 9.8 | 13.8 | 87.9 | 4.6 | 38.7 | 6.8 |
| CDC | 100.7 | 103.9 | 108.9 | 51.1 | 9.6 | 13.9 | 85.7 | 5.8 | 43.0 | 7.3 |
| Buzz | 89.4 | - | - | 51.9 | 10.4 | 11.5 | 93.6 | 2.3 | 37.2 | 2.8 |
| Balster | **122.5** | **124.0** | **123.3** | 50.6 | 9.8 | 13.7 | 88.3 | 4.2 | 37.9 | 5.3 |
| ABI Voyager | 116.1 | - | - | 53.2 | 10.3 | 12.8 | 94.2 | 2.1 | 41.3 | 1.8 |
| AAC Synergy | **131.9** | - | - | 52.2 | 10.1 | 12.8 | 92.4 | 2.4 | 39.5 | 4.5 |
| | | | | | | | | | | |
| Experimental | | | | | | | | | | |
| MT16M05610 | 109.4 | - | - | 51.6 | 10.0 | 12.2 | 92.4 | 2.7 | 40.4 | 5.7 |
| MT16M01902 | **127.5** | - | - | 50.5 | 9.8 | 12.3 | 92.5 | 2.1 | 38.6 | 2.8 |
| MT16M01801 | 97.2 | - | - | 51.4 | 10.0 | 11.6 | 91.4 | 3.7 | 40.9 | 6.0 |
| MT16M01405 | 109.2 | - | - | 52.2 | 10.2 | 12.4 | 94.5 | 2.0 | 36.2 | 2.2 |
| MT16M00406 | 96.7 | - | - | 51.4 | 10.0 | 12.2 | 93.3 | 2.5 | 39.9 | 4.7 |
| Average | 119.2 | 122.6 | 121.4 | 50.3 | 9.8 | 12.7 | 86.1 | 5.3 | 37.3 | 4.6 |
| PLSD | 28.6 | 17.2 | 14.9 | 2.1 | 0.4 | 1.0 | 8.7 | 4.9 | 2.7 | 2.2 |
| CV% | 13.3 | 10.4 | 9.5 | 2.4 | 2.2 | 5.2 | 5.9 | 55.4 | 5.2 | 43.3 |
| Location x | 2 | 4 | 6 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |

1/ Yields are based on 48 pound standard bushel weight and adjusted to 13.0 percent moisture content.
2/ Grain protein values adjusted to 12% moisture basis.
3/ Lodging severity scores of 0 to 9 represent no lodging to all stems flat on the ground, respectively.
**Bold** Indicates highest yielding cultivar within a column.
**Bold** Indicates cultivars yielding equal to highest yielding cultivar within a column based on Fisher's protected LSD (p=0.05).

Table 8. Performance of 25 spring barley cultivars and experimental lines tested under dryland conditions at two locations in south central Montana during 2020. Yield is expressed as bu/a; test weight as lbs/a; moisture, protein, height as inches.

| Cultivar | Yield[1] 2020 | Yield 2019-20 | Yield 2018-20 | Test Weight | Grain Moisture | Grain[2] Protein | Plant Height |
|---|---|---|---|---|---|---|---|
| Commercial | | | | | | | |
| Opera | **58.4** | - | - | 51.7 | 10.2 | 10.6 | 26.1 |
| Odyssey | **66.1** | 65.4 | 67.7 | 51.9 | 10.2 | 11.0 | 26.7 |
| AC Metcalfe | 55.2 | 57.6 | 62.9 | 53.4 | 10.5 | 12.2 | 33.0 |
| Merit 57 | 37.8 | 51.2 | 57.5 | 51.7 | 10.3 | 11.8 | 30.0 |
| Leandra | **74.9** | - | - | 51.1 | 10.0 | 11.4 | 26.0 |
| Lavina | **66.0** | 65.2 | - | 50.2 | 10.4 | 12.1 | 33.6 |
| Hockett | 40.5 | 53.5 | 58.5 | 54.1 | 10.6 | 11.2 | 30.8 |
| Hays | **81.1** | 72.8 | - | 50.3 | 10.4 | 12.0 | 31.5 |
| Haxby | 55.0 | 57.4 | - | 54.6 | 10.4 | 11.8 | 29.5 |
| Growler | 49.9 | 55.9 | 59.9 | 51.5 | 10.5 | 12.2 | 30.6 |
| Genie | **64.8** | 69.7 | 69.7 | 53.0 | 10.3 | 11.2 | 28.8 |
| Expedition | 40.5 | - | **-** | 53.4 | 10.4 | 11.7 | 27.0 |
| Ellinore | **60.7** | **-** | **-** | 49.3 | 10.2 | 10.8 | 26.1 |
| Diablo | **69.6** | **-** | **-** | 50.0 | 10.2 | 10.8 | 27.1 |
| Craft | 54.0 | **-** | **-** | 54.1 | 10.2 | 12.6 | 34.2 |
| CDC Copeland | **62.3** | 66.0 | 68.0 | 52.8 | 10.4 | 12.7 | 34.3 |
| Buzz | 38.6 | - | - | 53.6 | 10.8 | 10.5 | 29.3 |
| Balster | 55.1 | 59.6 | 64.5 | 51.7 | 10.4 | 11.9 | 32.6 |
| ABI Voyager | 35.0 | - | - | 52.1 | 10.6 | 12.4 | 34.0 |
| AAC Synergy | **60.1** | - | - | 51.9 | 9.9 | 11.9 | 32.9 |
| | | | | | | | |
| Experimental | | | | | | | |
| MT16M05610 | 42.5 | - | - | 52.5 | 10.4 | 11.2 | 31.3 |
| MT16M01902 | 45.9 | - | - | 47.7 | 10.4 | 10.8 | 29.9 |
| MT16M01801 | 39.7 | - | - | 51.8 | 10.4 | 10.2 | 31.8 |
| MT16M01405 | 44.0 | - | - | 52.2 | 10.5 | 11.1 | 30.2 |
| MT16M00406 | 46.4 | - | - | 52.4 | 10.3 | 10.6 | 32.9 |
| Average | 53.8 | 61.3 | 63.6 | 52.0 | 10.4 | 11.5 | 30.4 |
| PLSD (p=0.05) | 25.6 | ns | ns | 2.7 | 0.3 | 1.3 | 2.2 |
| CV% | 22.6 | 14.3 | 12.5 | 1.6 | 1.9 | 2.9 | 5.6 |
| Location x Year | 2 | 4 | 6 | 2 | 2 | 2 | 2 |

1/ Yields are based on 48 pound standard bushel weight and adjusted to 13.0 percent moisture content.
2/ Grain protein values adjusted to 12% moisture basis.
**Bold** Indicates highest yielding cultivar within a column.
**Bold** Indicates cultivars yielding equal to highest yielding cultivar within a column based on Fisher's protected LSD (p=0.05).
ns Indicates no significant difference between cultivars within a column based on Fisher's protected LSD (p=0.05).