**Project Title**: Evaluation of spring barley cultivar performance under continuous-crop and crop-crop-fallow systems in central Montana

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**Objective:**
Evaluate the performance of spring barley cultivars in central Montana environments.

**Results:**
The 2013 NTCC spring barley performance trials were conducted at CARC-Moccasin, two seeding dates, Denton and Geraldine. Barley grain yields were much higher at Moccasin and Geraldine than near Denton (Tables 1-4). 2013 yields in Denton were roughly 4.5 bu/a lower than the site's 5-year average (Table 6). Moccasin contained two trials, involving different seeding dates. The highest yielding cultivar in the earlier seeded Moccasin trail was line MT070158, while the highest yield in the later seeded trial was line MT090180. Development line MT080279 was the highest yielding entry at the Denton and Geraldine locations. Haxby, Champion, Gallatin and line MT070159 were other entries that yielded well.

2013 Barley test weight and protein levels were near or above the 5-year averages for the three locations (Tables 8-10 and 11-13, respectively). The test weights have been above the 48 lbs/bu. While continuous crop barley often has heavier test weights, the drier early post seeding conditions appear to contribute to even higher test weights, possibly through reduced yield potential during early development stages. Haxby had high test weight for all four trials. The Moccasin locations protein was above the five average. A combination of remnant rooting zone N from the drought stress yellow mustard crop and more effective use of urea N due to application closer to significant precipitation events. The Denton and Geraldine 2013 protein levels were closer levels preferred for malt barley and less than the five year average (Tables 12-13). A high level of winter wheat residue, at Geraldine, may have caused some urease induced urea N volatilization. The malt cultivar Conrad and the feed barley CDC Cowboy were both ranked in the highest quartile for multi-year protein percentage at all three locations. Harrington, Metcalfe and Eslick were ranked high for grain protein in specific trials. Haxby, Hockett and Champion ranked low for grain protein (Tables 11-13).

**Summary:**
For ease of assessment, Haxby is used as a standard for multi-year yield, test weight and protein performance, the performance of entries is compared to Haxby for the same years. Haxby generally has the highest mean yield and test weight. For grain protein, Haxby is often near the bottom in multi-year comparisons.

MSU-MAES Barley breeder coordinates the selection of entries and the preparation and distribution of seed for these trials.

**Funding Summary:**
Expenditure information to be provided by OSP. No other grant support was provided.

**MWBC FY2011 Grant Submission Plans:**
It is planned to submit this project for funding consideration in the next fiscal year.

Table 1 2013 Mid-April barley performance in no-till continuous crop near Moccasin.
Exp. 133670 Central Agricultural Research Center. Moccasin, Montana

| Entry | Head Date | Plant Ht | Yield | Yield | Test Wt | Plump | Protein |
|---|---|---|---|---|---|---|---|
| | Julian | " | lbs/a | bu/a | lb/bu. | % | % |
| MT070158 | 180.0 | 27 | 2914 | 60.7 | 45.0 | 65 | 15.7 |
| MT080279 | 180.3 | 28 | 2814 | 58.6 | 46.5 | 52 | 15.5 |
| MT070159 | 180.3 | 25 | 2798 | 58.3 | 46.0 | 33 | 17.1 |
| Haxby | 179.7 | 28 | 2783 | 58.0 | 49.0 | 49 | 15.4 |
| MT090180 | 182.3 | 28 | 2706 | 56.4 | 48.5 | 74 | 14.9 |
| Champion | 181.0 | 28 | 2661 | 55.4 | 47.0 | 26 | 16.0 |
| Eslick | 182.3 | 25 | 2584 | 53.8 | 50.0 | 30 | 17.2 |
| MT090190 | 182.0 | 29 | 2581 | 53.8 | 48.0 | 47 | 15.2 |
| Hockett | 181.0 | 28 | 2573 | 53.6 | 48.5 | 61 | 15.5 |
| Tradtion | 181.3 | 28 | 2557 | 53.3 | 44.0 | 27 | 15.6 |
| Harrington | 182.0 | 27 | 2547 | 53.1 | 45.0 | 52 | 16.4 |
| Geraldine | 182.3 | 26 | 2437 | 50.8 | 47.0 | 17 | 17.4 |
| Conrad | 182.3 | 25 | 2426 | 50.5 | 46.0 | 42 | 18.2 |
| Gallatin | 181.3 | 27 | 2361 | 49.2 | 48.5 | 31 | 17.6 |
| Metcalfe | 182.0 | 27 | 2287 | 47.6 | 47.5 | 40 | 18.1 |
| CDC Cowboy | 182.7 | 32 | 2007 | 41.8 | 47.5 | 39 | 18.5 |
| Mean | 181.4 | 27.4 | 2565 | 53.4 | 47.13 | 42.8 | 16.56 |
| P-Value | 0.00 | 0.00 | 0.00 | | 0.02 | 0.00 | 0.00 |
| CV 1 | 0.4 | 5.9 | 7.8 | | 2.8 | 0.0 | 0.0 |
| LSD(0.05) | 1.21 | 2.70 | 335.00 | | 2.86 | 0.00 | 0.00 |

Seed Date: 4/19/2013 Soil: 2"Temp.: 6C Moist depth: 18 "
Fertilizer: 10-10-10-05 NPKS w/sd 60 lbs N preplant top dress
Harvest: 8-Aug-13
Comments: The yellow mustard stubble provided a good seed bed for no-till continous cropping. Post plant glyphosate application was used to control a scattering of weeds. Primarily volunteer cereal plants.

Table 2 Early May seeded barley performance in no-till continuous crop near Moccasin.
Exp 1336702 Central Agricultural Research Center. Moccasin, Montana

| Entry | Headdate | Plant Ht | Yield | Yield | Test Wt | Plump | Protein |
|---|---|---|---|---|---|---|---|
| | Julian | " | lbs/a | bu/a | lb/bu | % | % |
| MT090180 | 185 | 26.4 | 2924 | 60.9 | 52.0 | 85 | 14.5 |
| Metcalfe | 185 | 26.8 | 2635 | 54.9 | 51.5 | 68 | 16.3 |
| MT080279 | 184 | 28.4 | 2584 | 53.8 | 48.5 | 71 | 15.8 |
| Chanpion | 184 | 28.0 | 2575 | 53.6 | 52.0 | 69 | 14.9 |
| MT070158 | 184 | 27.2 | 2522 | 52.5 | 50.5 | 66 | 15.9 |
| Geraldine | 185 | 25.2 | 2488 | 51.8 | 49.5 | 23 | 18.1 |
| Conrad | 186 | 25.2 | 2424 | 50.5 | 49.5 | 73 | 19.6 |
| Haxby | 185 | 28.8 | 2390 | 49.8 | 52.0 | 24 | 18.7 |
| MT070159 | 184 | 26.0 | 2317 | 48.3 | 49.5 | 29 | 18.3 |
| Tradition | 184 | 29.2 | 2246 | 46.8 | 48.0 | 37 | 18.2 |
| Eslick | 185 | 24.8 | 2132 | 44.4 | 52.0 | 10 | 20.6 |
| CDC Cowboy | 187 | 29.2 | 2115 | 44.1 | 51.0 | 41 | 18.0 |
| MT090190 | 184 | 28.4 | 2057 | 42.9 | 52.0 | 62 | 18.2 |
| Hockett | 184 | 28.0 | 2051 | 42.7 | 49.5 | 34 | 18.1 |
| Harrington | 185 | 27.2 | 1997 | 41.6 | 50.0 | 58 | 20.1 |
| Gallatin | 185 | 26.0 | 1966 | 41.0 | 49.0 | 29 | 19.0 |
| Mean | 184.8 | 27.2 | 2339 | 48.7 | 50.41 | 48.7 | 17.81 |
| P-Value | | | 0.09 | | 0.01 | | |
| CV 1 | | | 15.3 | | 2.1 | | |
| LSD(0.05) | | | 596 | 12.4 | 2.22 | | |

Seed Date: 5/7/2013 Soil: 2"Temp.: 19C Moist depth: 18 "
Fertilizer: 10-10-10-05 NPKS w/sd 60 lbs N preplant top dress
Harvest: 23-Aug-13
Comments: This trial was seeded in same strip as the April 19 seeding, about 200 ft away. Above average June precipitation and late July-early August humidity reduced seed fill stress.

Table 3 2013 Barley performance in no-till continuous crop near Denton
Exp 133671 Central Agricultural Research Center. Moccasin Montana.

| Rep | Plant Ht | Yield | Yield | Test Wt | Plump | Protein |
|---|---|---|---|---|---|---|
| | in. | lbs. | bu/a | lb/bu | % | % |
| MT080279 | 17 | 1929 | 40.2 | 54.0 | 90.5 | 12.5 |
| MT070159 | 15 | 1746 | 36.4 | 53.0 | 77.9 | 12.2 |
| Harrington | 17 | 1738 | 36.2 | 53.5 | 89.3 | 12.6 |
| Champion | 20 | 1683 | 35.1 | 54.0 | 82.0 | 11.6 |
| Haxby | 19 | 1682 | 35.0 | 56.0 | 82.6 | 12.4 |
| Gallatin | 19 | 1681 | 35.0 | 53.5 | 81.9 | 12.3 |
| Eslick | 17 | 1658 | 34.6 | 53.0 | 62.4 | 12.5 |
| Metcalfe | 21 | 1620 | 33.7 | 54.0 | 86.9 | 12.1 |
| MT070158 | 18 | 1595 | 33.2 | 55.0 | 93.0 | 13.0 |
| MT090180 | 19 | 1576 | 32.8 | 54.0 | 83.0 | 11.3 |
| Conrad | 19 | 1557 | 32.5 | 53.0 | 91.8 | 14.1 |
| Geraldine | 16 | 1536 | 32.0 | 54.0 | 82.2 | 12.2 |
| MT090190 | 23 | 1488 | 31.0 | 54.5 | 93.3 | 11.6 |
| Hockett | 20 | 1426 | 29.7 | 54.0 | 91.8 | 12.2 |
| Tradition | 22 | 1316 | 27.4 | 52.5 | 87.0 | 13.3 |
| CDC Cowboy | 26 | 1270 | 26.5 | 54.0 | 92.2 | 13.7 |
| Mean | 19.25 | 1594 | 33.21 | 53.88 | 85.5 | 12.5 |
| P-Value | 0.00 | 0.06 | 0.06 | 0.13 | | |
| CV 1 | 0 | 12.98 | 12.96 | 1.66 | | |
| LSD(0.05) | 0 | 345.00 | 7.18 | 1.91 | | |

Seed Date: 4/26/2013 NTCC afte Soil: 2"Temp.: 8C Moist depth: 18 "
Fertilizer: 10-10-10-05 NPKS w/seed + 60 N top dress as urea.
Harvest: 22-Aug-13
Comments: While the untilled lentil stubble provided a good seedbed, the lack of good surface soil moisture, combined with delayed abundant spring moisture contributed to poor tillering and lower yields.

Table 4 2013 Barley performance in no-till recrop near Geraldine.
Exp 133672 Central Agricultural Research Center. Moccasin Montana.

| Rep | Plant Ht. | Yield | Yield | Test Wt | Plump | Protein |
|---|---|---|---|---|---|---|
| | | lbs. | bu/a | lb/bu | % | % |
| MT080279 | | 2819 | 60.6 | 54.9 | 90.1 | 11.7 |
| MT070159 | | 2657 | 55.4 | 55.7 | 92.5 | 11.3 |
| Gallatin | | 2567 | 53.5 | 54.7 | 86.6 | 11.9 |
| MT070158 | | 2566 | 53.5 | 54.9 | 92.1 | 11.2 |
| Eslick | | 2557 | 53.3 | 54.4 | 82.0 | 10.9 |
| Geraldine | | 2552 | 53.2 | 54.7 | 80.8 | 11.2 |
| Hockett | | 2521 | 52.5 | 56.0 | 93.7 | 10.7 |
| Conrad | | 2490 | 51.9 | 53.1 | 87.9 | 11.6 |
| Metcalfe | | 2487 | 51.8 | 55.5 | 91.1 | 10.9 |
| Tradition | | 2481 | 51.7 | 54.6 | 91.1 | 11.0 |
| Harrington | | 2480 | 51.7 | 53.6 | 89.0 | 11.6 |
| Champion | | 2474 | 51.6 | 55.1 | 90.4 | 10.9 |
| Haxby | | 2467 | 51.4 | 55.8 | 84.4 | 10.4 |
| MT090180 | | 2457 | 51.2 | 54.4 | 89.7 | 10.2 |
| MT090190 | | 2413 | 50.3 | 54.6 | 92.5 | 10.3 |
| CDC Cowboy | | 2355 | 49.1 | 54.4 | 94.8 | 13.0 |
| Mean | | 2522 | 52.65 | 54.74 | 89.29 | 11.17 |
| P-Value | | 0.12 | 0.04 | 0.00 | | |
| CV 1 | | 5.67 | 5.89 | 0.96 | | |
| LSD(0.05) | | 238.40 | 5.17 | 1.12 | | |

Seed Date: 06-May -13 NTCCF winter wht stubble.
Soil: Soil: 2"Temp.: 18C Moisture Probe depth: 24 "
Fertilizer: 10-10-10-05 w/sd 60 lbs N preplant top dress.
Harvest: 23-Aug-13 Field: strip by east fence
Comments: Heavy straw residue interfered with obtaining the ideal stand. However, the stands were uniform across treatments. Feed barley was seeded around the trial site.

Table 5 Moccasin multi-year spring barley variety grain yields in no-till CC.
Exp 133670 Central Agricultural Research Center. Moccasin, Montana

| Selected Entries | 2009 | 2010 | 2011 | 2012 | 2013 Early | 2013 Late | Average | Haxby same yrs |
|---|---|---|---|---|---|---|---|---|
| | | | (bu/a) | | | | | |
| **Champion** | 49.2 | 51.1 | | 27.4 | 55.4 | 53.6 | 47.3 | 50.5 |
| **Conrad** | 50.9 | 55.9 | 36.1 | 30.0 | 50.5 | 50.5 | 45.6 | 48.2 |
| **Cowboy** | | | | 23.2 | 41.8 | 44.1 | 36.4 | 48.5 |
| **Eslick** | | | | 29.5 | 53.8 | 44.4 | 42.6 | 48.5 |
| **Gallatin** | 46.1 | 59.6 | 30.8 | 29.3 | 49.2 | 41.0 | 42.7 | 48.2 |
| **Harrington** | 46.1 | 39.7 | 28.4 | 22.4 | 53.1 | 41.6 | 38.6 | 48.2 |
| **Haxby** | **48.4** | **58.8** | **36.3** | **37.6** | **58.0** | **49.8** | **48.2** | 48.2 |
| **Hockett** | 40.8 | 56.4 | 32.4 | 25.0 | 53.6 | 42.7 | 41.8 | 48.2 |
| **Metcalfe** | 41.6 | 45.7 | 28.7 | 24.5 | 47.6 | 54.9 | 40.5 | 48.2 |
| **Tradition** | | | 31.1 | 28.1 | 53.3 | 46.8 | 39.8 | 45.4 |
| Yearly Mean | 46.2 | 52.5 | 32.0 | 27.7 | 51.6 | 46.9 | 42.3 | 48.2 |

(Figure 1)

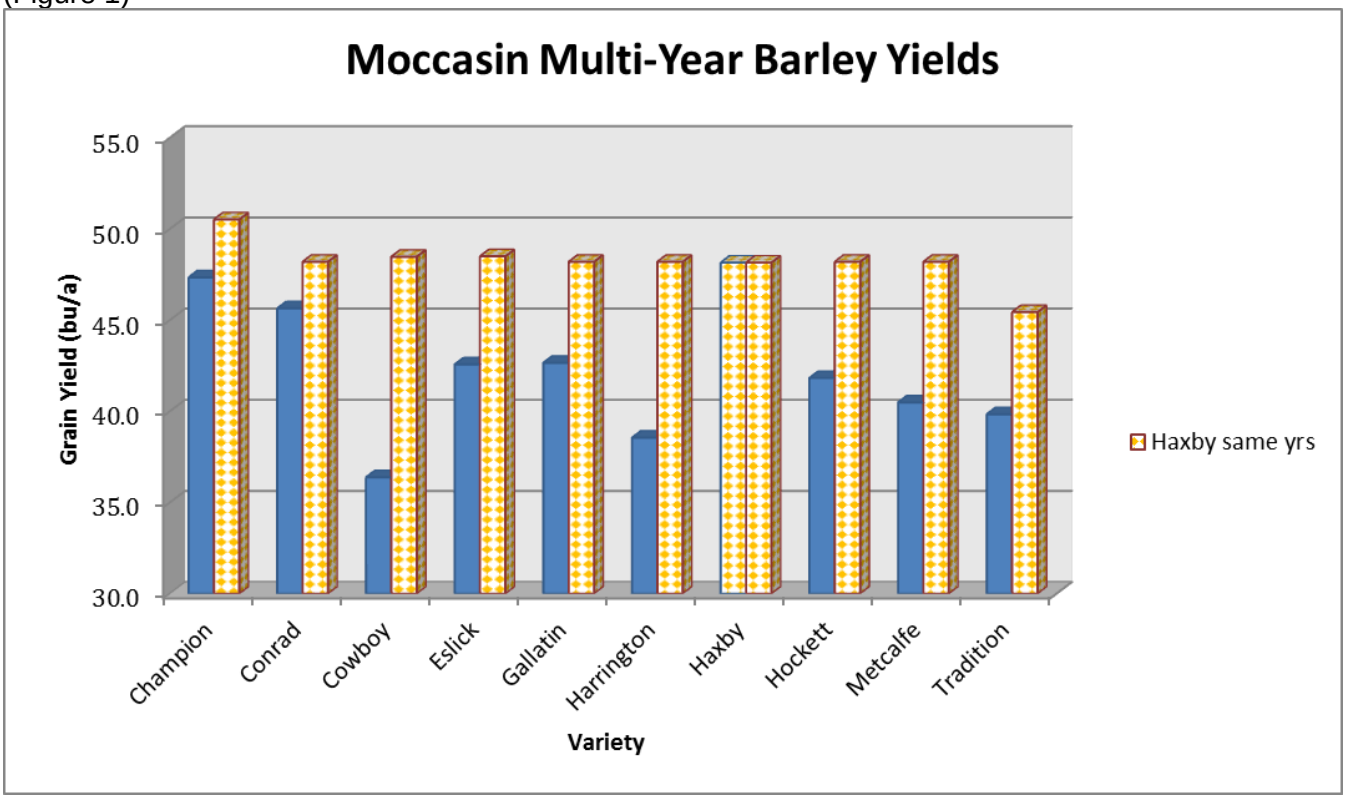

Table 6 Denton multi-year spring barley variety grain yields in no-till CC.
Exp 133671 Central Agricultural Research Center. Moccasin, Montana

| Selected Entries | 2009 | 2010 | 2011 | 2012 | 2013 | Average | Haxby same yrs |
|---|---|---|---|---|---|---|---|
| | | | (bu/a) | | | | |
| **Champion** | 58.0 | 50.0 | | 44.5 | 35.1 | 46.9 | 44.6 |
| **Conrad** | 40.8 | 56.1 | 20.7 | 44.8 | 32.5 | 39.0 | 39.9 |
| **Cowboy** | | | | 38.0 | 26.5 | 32.2 | 40.1 |
| **Eslick** | | | | 38.9 | 34.6 | 36.7 | 40.1 |
| **Gallatin** | 42.3 | 51.5 | 20.8 | 40.2 | 35.0 | 38.0 | 39.9 |
| **Harrington** | 37.7 | 47.2 | 19.7 | 35.6 | 36.2 | 35.3 | 39.9 |
| **Haxby** | **39.7** | **58.4** | **21.1** | **45.2** | **35.0** | **39.9** | 39.9 |
| **Hockett** | 45.9 | 46.7 | 22.6 | 40.6 | 29.7 | 37.1 | 39.9 |
| **Metcalfe** | 42.1 | 48.6 | 18.6 | 39.3 | 33.7 | 36.5 | 39.9 |
| **Tradition** | | | 21.2 | 39.1 | 27.4 | 29.2 | 33.8 |
| Yearly Mean | 43.8 | 51.2 | 20.7 | 40.6 | 32.6 | 37.1 | 39.8 |

(Figure 2)

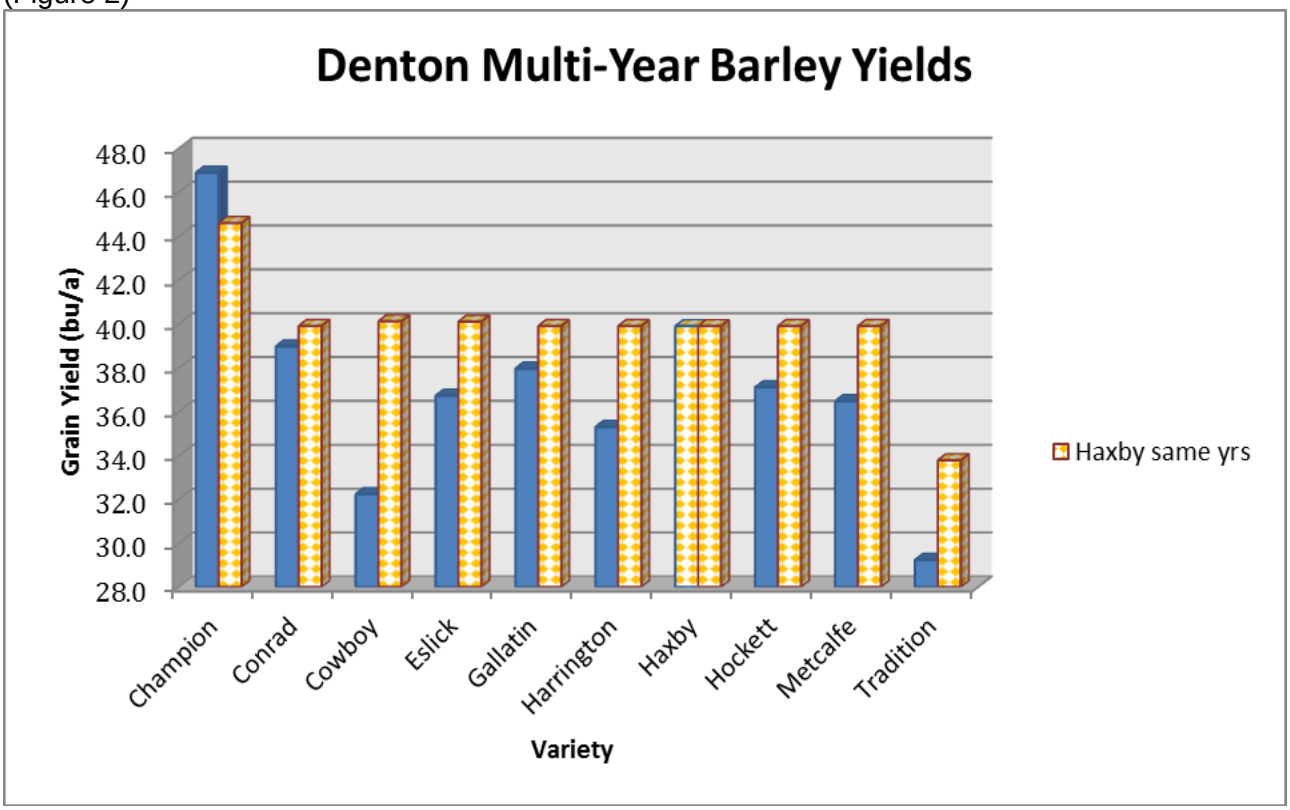

Table 7 Geraldine multi-year spring barley variety grain yields in no-till CC.
Exp 133672 Central Agricultural Research Center. Moccasin, Montana

| Selected Entries | 2009 | 2010 | 2011 | 2012 | 2013 | Average | Haxby same yrs |
|---|---|---|---|---|---|---|---|
| | | | (bu/a) | | | | |
| **Champion** | | | | 59.7 | 51.6 | 55.7 | 58.0 |
| **Conrad** | | | | 57.3 | 51.9 | 54.6 | 58.0 |
| **Cowboy** | | | | 48.0 | 49.1 | 48.5 | 58.0 |
| **Eslick** | | | | 49.9 | 53.3 | 51.6 | 58.0 |
| **Gallatin** | | | | 50.4 | 53.5 | 51.9 | 58.0 |
| **Harrington** | | | | 53.0 | 51.7 | 52.3 | 58.0 |
| **Haxby** | | | | **64.6** | **51.4** | **58.0** | 58.0 |
| **Hockett** | | | | 53.7 | 52.5 | 53.1 | 58.0 |
| **Metcalfe** | | | | 51.1 | 51.8 | 51.5 | 58.0 |
| **Tradition** | | | | 56.5 | 51.7 | 54.1 | 58.0 |
| Yearly Mean | | | | 54.4 | 51.8 | 53.1 | 58.0 |

(Figure 3)

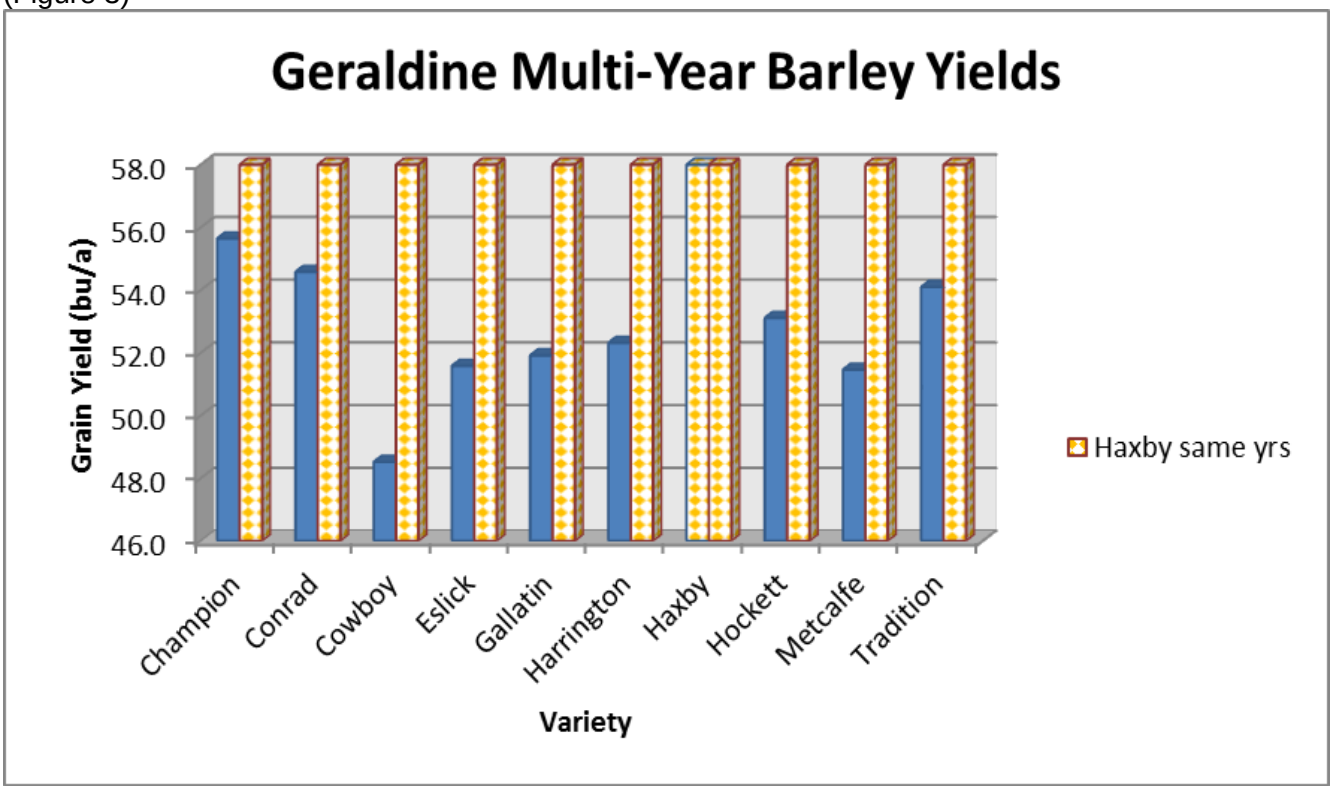

Table 8 Moccasin multi-year barley variety grain test weights on no-till CC.
Exp 133670 Central Agricultural Research Center. Moccasin, Montana

| Selected Entries | 2009 | 2010 | 2011 | 2012 | 2013 Early | 2013 Late | Average | Haxby same yrs |
|---|---|---|---|---|---|---|---|---|
| | | | (lb/bu) | | | | | |
| **Champion** | 54.2 | 51.3 | | 52.7 | 47.0 | 52.0 | 51.4 | 52.4 |
| **Conrad** | 52.9 | 50.5 | 50.7 | 51.8 | 46.0 | 49.5 | 50.2 | 52.7 |
| **Cowboy** | | | | 52.7 | 47.5 | 51.0 | 50.4 | 51.5 |
| **Eslick** | | | | 51.4 | 50.0 | 52.0 | 51.1 | 51.5 |
| **Gallatin** | 53.3 | 51.1 | 52.8 | 51.2 | 48.5 | 49.0 | 51.0 | 52.7 |
| **Harrington** | 53.1 | 50.5 | 50.6 | 51.3 | 45.0 | 50.0 | 50.1 | 52.7 |
| **Haxby** | **54.6** | **53.2** | **54.1** | **53.4** | **49.0** | **52.0** | **52.7** | 52.7 |
| **Hockett** | 54.3 | 52.4 | 52.6 | 51.6 | 48.5 | 49.5 | 51.5 | 52.7 |
| **Metcalfe** | 54.1 | 50.7 | 51.8 | 51.7 | 47.5 | 51.5 | 51.2 | 52.7 |
| **Tradition** | | | 50.9 | 49.7 | 44.0 | 48.0 | 48.2 | 52.1 |
| Yearly Mean | 53.8 | 51.4 | 51.9 | 51.7 | 47.3 | 50.5 | 50.8 | 52.4 |

(Figure 4)

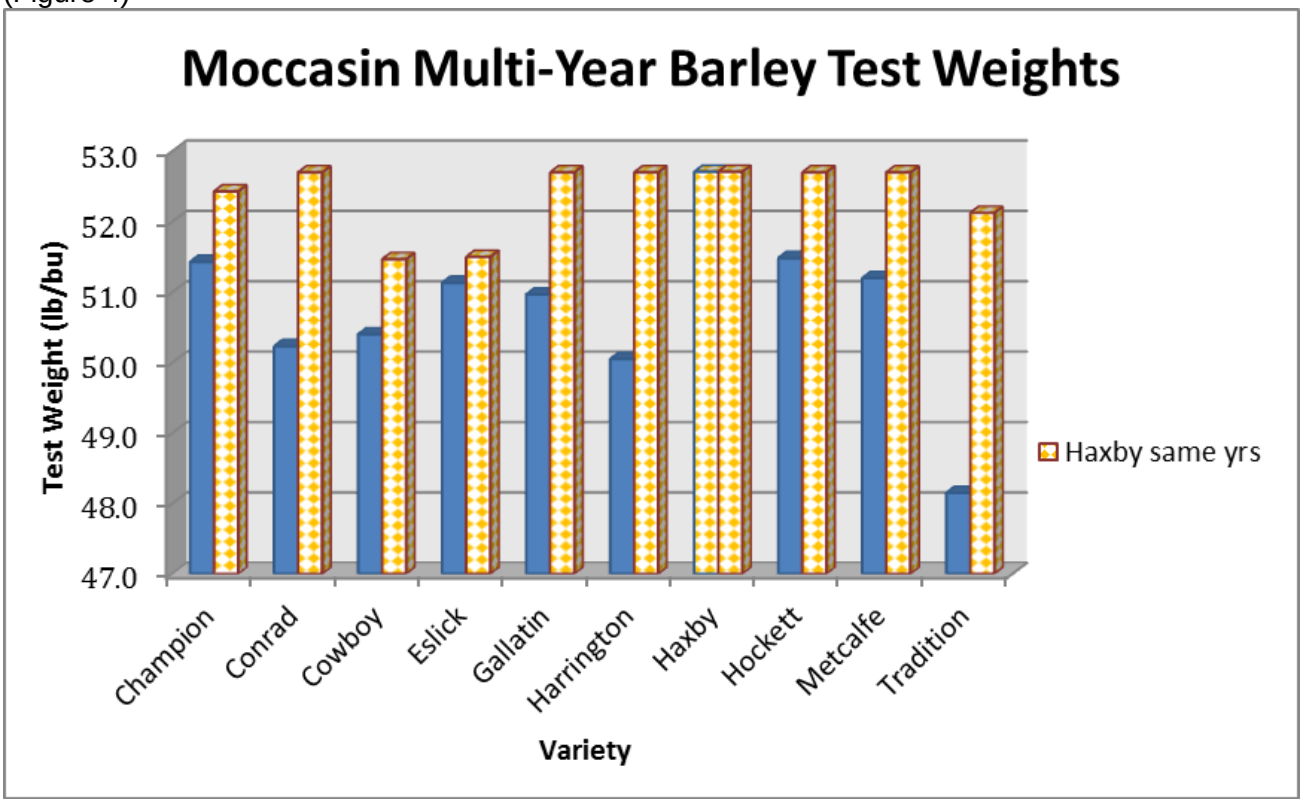

Table 9 Denton multi-year spring barley variety grain test weights in no-till CC.
Exp 133671 Central Agricultural Research Center. Moccasin, Montana

| Selected Entries | 2009 | 2010 | 2011 | 2012 | 2013 | Average | Haxby same yrs |
|---|---|---|---|---|---|---|---|
| | | | (lb/bu) | | | | |
| **Champion** | 56.5 | 54.9 | | 49.4 | 54.0 | 53.7 | 53.8 |
| **Conrad** | 55.0 | 53.0 | 53.0 | 49.1 | 53.0 | 52.6 | 53.4 |
| **Cowboy** | | | | 48.6 | 54.0 | 51.3 | 53.1 |
| **Eslick** | | | | 47.1 | 53.0 | 50.0 | 53.1 |
| **Gallatin** | 55.1 | 53.5 | 52.5 | 49.7 | 53.5 | 52.9 | 53.4 |
| **Harrington** | 55.4 | 53.1 | 53.5 | 44.9 | 53.5 | 52.1 | 53.4 |
| **Haxby** | **55.0** | **54.2** | **51.5** | **50.2** | **56.0** | **53.4** | 53.4 |
| **Hockett** | 55.8 | 53.9 | 54.0 | 49.1 | 54.0 | 53.4 | 53.4 |
| **Metcalfe** | 55.6 | 52.8 | 53.0 | 46.5 | 54.0 | 52.4 | 53.4 |
| **Tradition** | | | 51.0 | 50.3 | 52.5 | 51.3 | 52.6 |
| Yearly Mean | 55.5 | 53.6 | 52.6 | 48.5 | 53.8 | 52.3 | 53.3 |

(Figure 5)

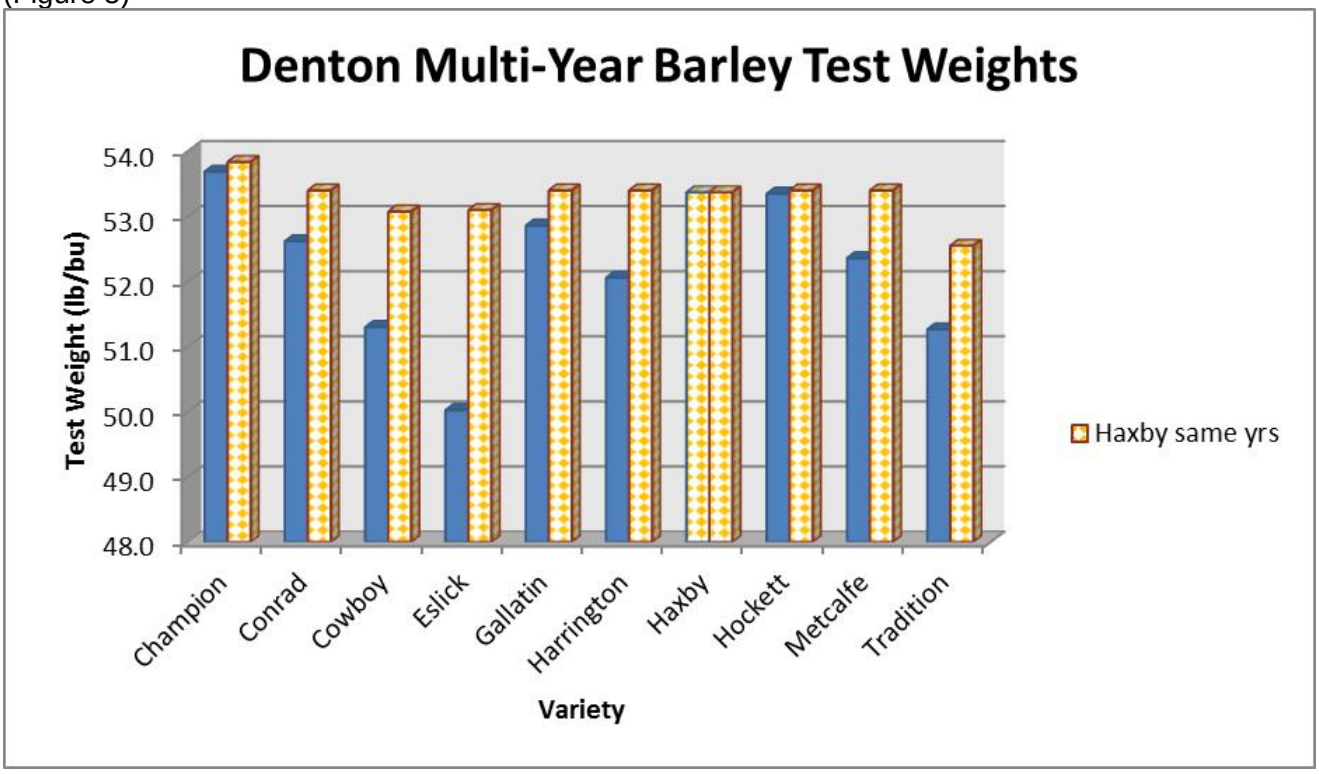

Table 10 Geraldine multi-year spring barley variety grain test weights in no-till CC.
Exp 133672 Central Agricultural Research Center. Moccasin, Montana

| Selected Entries | 2009 | 2010 | 2011 | 2012 | 2013 | Average | Haxby same yrs |
|---|---|---|---|---|---|---|---|
| | | | (lb/bu) | | | | |
| **Champion** | | | | 54.1 | 55.1 | 54.6 | 56.0 |
| **Conrad** | | | | 51.4 | 53.1 | 52.2 | 56.0 |
| **Cowboy** | | | | 53.8 | 54.4 | 54.1 | 56.0 |
| **Eslick** | | | | 52.7 | 54.4 | 53.5 | 56.0 |
| **Gallatin** | | | | 51.9 | 54.7 | 53.3 | 56.0 |
| **Harrington** | | | | 52.1 | 53.6 | 52.8 | 56.0 |
| **Haxby** | | | | **56.1** | **55.8** | **56.0** | 56.0 |
| **Hockett** | | | | 54.2 | 56.0 | 55.1 | 56.0 |
| **Metcalfe** | | | | 52.7 | 55.5 | 54.1 | 56.0 |
| **Tradition** | | | | 51.4 | 54.6 | 53.0 | 56.0 |
| Yearly Mean | | | | 53.0 | 54.7 | 53.8 | 56.0 |

(Figure 6)

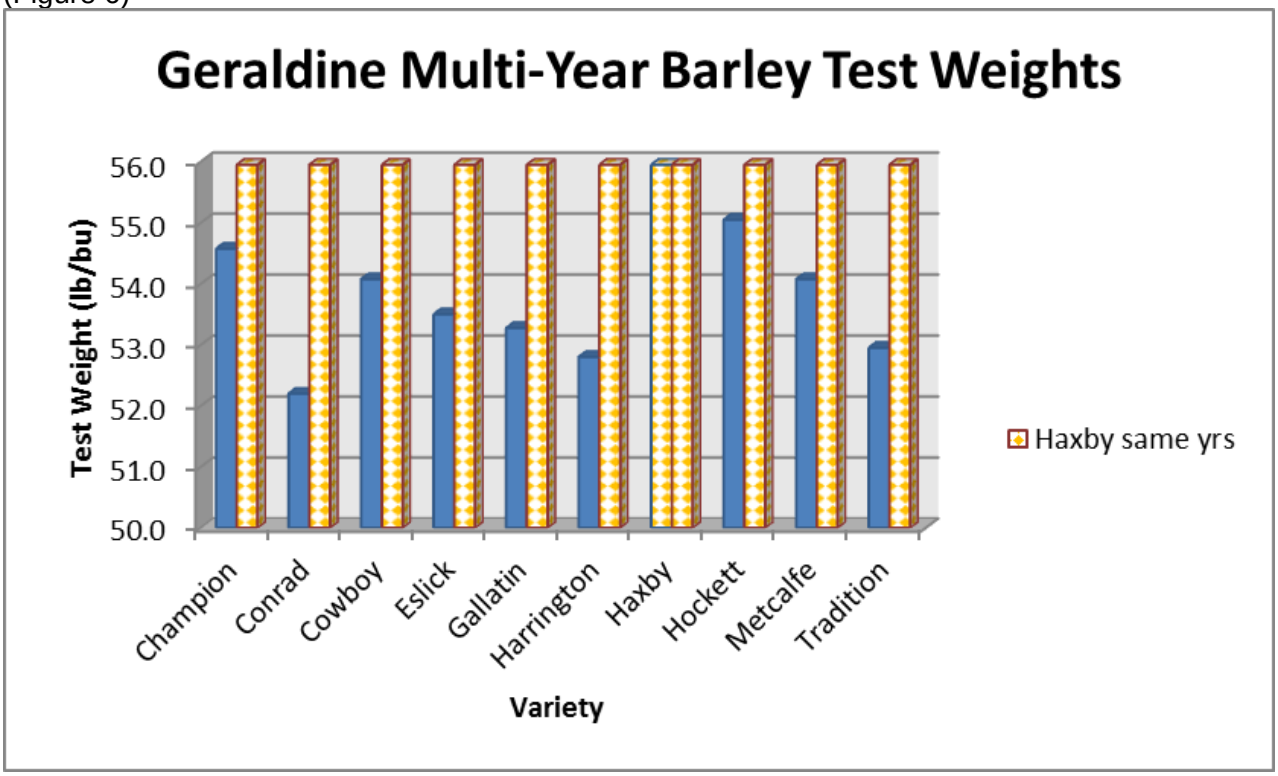

Table 11 Moccasin multi-year barley variety grain protein on no-till CC.
Exp 133670 Central Agricultural Research Center. Moccasin, Montana

| Selected Entries | 2009 | 2010 | 2011 | 2012 | 2013 Early | 2013 Late | Average | Haxby same yrs |
|---|---|---|---|---|---|---|---|---|
| | | | (%) | | | | | |
| **Champion** | 14.2 | 11.1 | | 16.6 | 16.0 | 14.9 | 14.6 | 15.3 |
| **Conrad** | 16.1 | 12.8 | 15.5 | 17.9 | 18.2 | 19.6 | 16.7 | 15.1 |
| **Cowboy** | | | | 17.8 | 18.5 | 18.0 | 18.1 | 16.9 |
| **Eslick** | | | | 17.4 | 17.2 | 20.6 | 18.4 | 16.9 |
| **Gallatin** | 15.1 | 10.9 | 15.6 | 17.1 | 17.6 | 19.0 | 15.9 | 15.1 |
| **Harrington** | 15.0 | 12.1 | 16.2 | 17.9 | 16.4 | 20.1 | 16.3 | 15.1 |
| **Haxby** | **14.8** | **10.9** | **14.2** | **16.7** | **15.4** | **18.7** | **15.1** | 15.1 |
| **Hockett** | 14.4 | 12.0 | 15.1 | 16.6 | 15.5 | 18.1 | 15.3 | 15.1 |
| **Metcalfe** | 15.5 | 11.6 | 16.1 | 18.6 | 18.1 | 16.3 | 16.0 | 15.1 |
| **Tradition** | | | 14.6 | 17.1 | 15.6 | 18.2 | 16.4 | 16.3 |
| Yearly Mean | 15.0 | 11.6 | 15.3 | 17.4 | 16.9 | 18.4 | 16.3 | 15.6 |

(Figure 7)

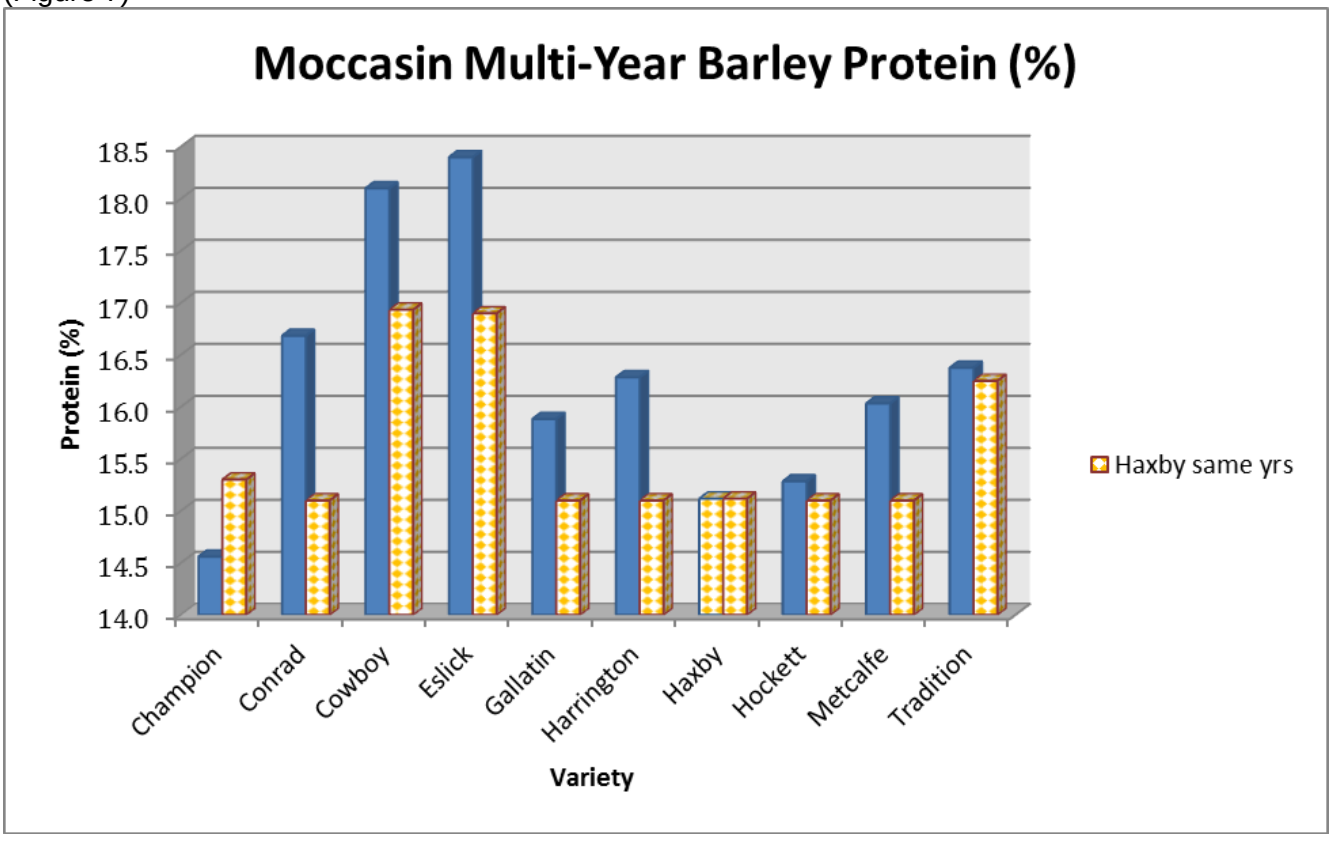

Table 12 Denton multi-year spring barley variety grain protein in no-till CC.
Exp 133671 Central Agricultural Research Center. Moccasin, Montana

| Selected Entries | 2009 | 2010 | 2011 | 2012 | 2013 | Average | Haxby same yrs |
|---|---|---|---|---|---|---|---|
| | | | (%) | | | | |
| **Champion** | 13.4 | 12.4 | | 14.3 | 11.6 | 12.9 | 13.2 |
| **Conrad** | 15.0 | 12.5 | 14.4 | 15.7 | 14.1 | 14.3 | 13.5 |
| **Cowboy** | | | | 15.9 | 13.7 | 14.8 | 13.5 |
| **Eslick** | | | | 16.5 | 12.5 | 14.5 | 13.5 |
| **Gallatin** | 14.4 | 12.7 | 14.8 | 15.4 | 12.3 | 13.9 | 13.5 |
| **Harrington** | 14.4 | 13.9 | 17.0 | 16.7 | 12.6 | 14.9 | 13.5 |
| **Haxby** | **13.7** | **12.1** | **14.6** | **14.5** | **12.4** | **13.5** | 13.5 |
| **Hockett** | 13.5 | 12.2 | 14.1 | 14.8 | 12.2 | 13.4 | 13.5 |
| **Metcalfe** | 14.9 | 13.4 | 15.1 | 17.9 | 12.1 | 14.7 | 13.5 |
| **Tradition** | | | 13.3 | 13.8 | 13.3 | 13.5 | 13.8 |
| Yearly Mean | 14.2 | 12.7 | 14.8 | 15.6 | 12.7 | 14.0 | 13.5 |

(Figure 8)

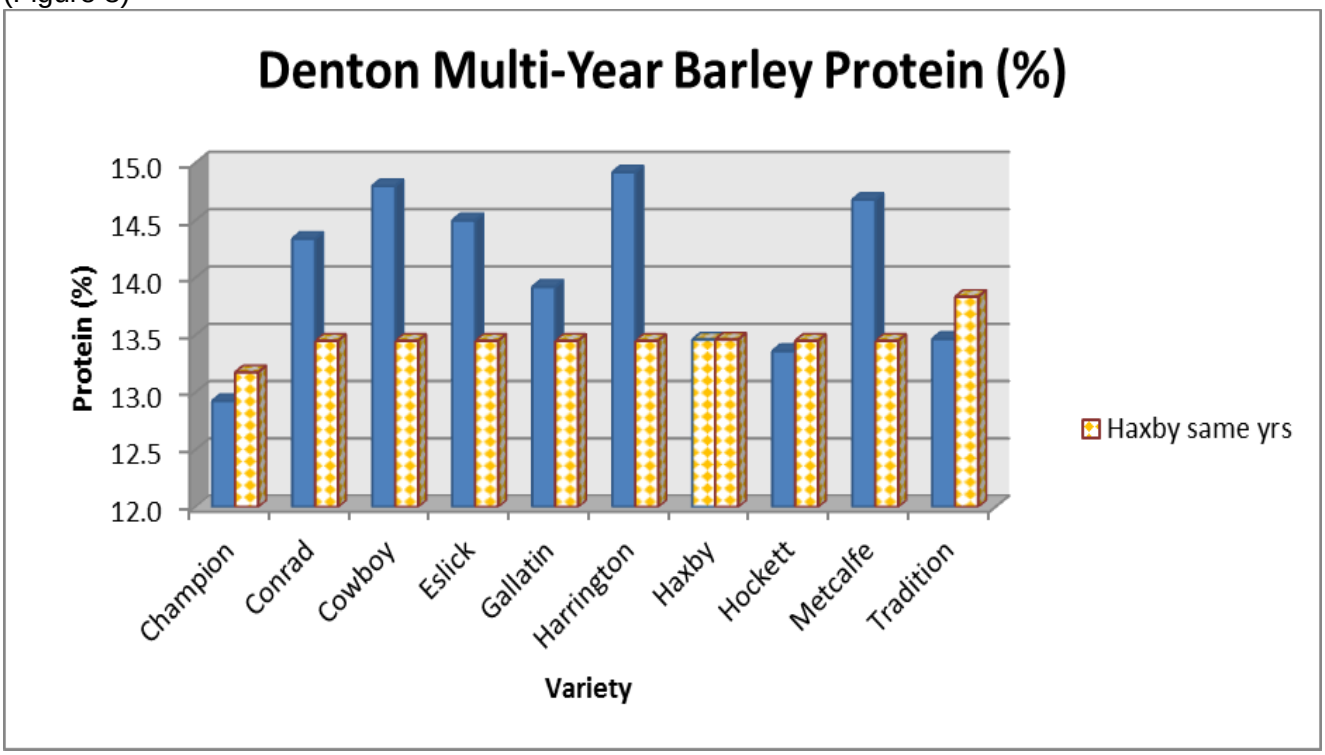

Table 13 Geraldine multi-year spring barley variety grain protein in no-till CC.
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| Selected Entries | 2009 | 2010 | 2011 | 2012 | 2013 | Average | Haxby same yrs |
|---|---|---|---|---|---|---|---|
| | | | (%) | | | | |
| **Champion** | | | | 11.4 | 10.9 | 11.2 | 11.3 |
| **Conrad** | | | | 13.5 | 11.6 | 12.6 | 11.3 |
| **Cowboy** | | | | 13.3 | 13.0 | 13.2 | 11.3 |
| **Eslick** | | | | 12.9 | 10.9 | 11.9 | 11.3 |
| **Gallatin** | | | | 12.6 | 11.9 | 12.3 | 11.3 |
| **Harrington** | | | | 13.0 | 11.6 | 12.3 | 11.3 |
| **Haxby** | | | | **12.1** | **10.4** | **11.3** | 11.3 |
| **Hockett** | | | | 11.3 | 10.7 | 11.0 | 11.3 |
| **Metcalfe** | | | | 13.8 | 10.9 | 12.4 | 11.3 |
| **Tradition** | | | | 12.8 | 11.0 | 11.9 | 11.3 |
| Yearly Mean | | | | 12.7 | 11.3 | 12.0 | 11.3 |

(Figure 9)