Effects of Seeding Rate on Two Barley Varieties in the Brown Soil Zone

Note: This project is funded by Alberta Grains

Introduction

Barley production on the Canadian Prairies is generally for one of two industries, either for animal feed or for the malting industry. In both cases, seeding rate is an important consideration when a producer is planning for the crop year. Seeding rate can affect crop competition, disease presence and severity, as well as influences yield. Typical recommendations for dryland barley applications in Alberta are 30 seeds/ft^2 to target a plant stand of 25 plants/ft^2 after accounting for mortality (McLelland et al., 2009). This trial was designed to demonstrate the effect of increasing seeding rate on the yield and quality of one feed barley variety, CDC Austenson, and one malt barley variety, AAC Connect. Target seeding rates were 20, 25, 30 and 35 seeds/ft^2 (215, 269, 323, 377 seeds/m^2) for the trial.

Materials and Methods

A suitable location was determined for this trial, targeting canola stubble as to follow a typical crop rotation for the area. Varieties were selected based on overall prevalence in the area obtained by crop insurance reports and by Canadian Malt Barley Technical Centre (CMBTC) variety recommendations. The trial was seeded with Chinook Applied Research Association's (CARA) custom Henderson 500 seed drill. Seed was weighed according to the target rate outlined in the treatment plan using the formula:

$$\frac{g}{plot} = TKW \cdot \left(\frac{\frac{seeds}{m^2}}{1000}\right) \cdot plot\ area\ (m^2) \cdot \left(\frac{100}{germ.}\right)$$

Where: TKW = thousand kernel weight

germ. = germination

Treatments were randomized using Microsoft Excel to create a plot plan (Figure 1). The trial was seeded May 24, 2023. Initial plot size was 7.5m by 1.4m at seeding and trimmed to 5m by 1.4m before harvest. Plots were fertilized with 100lbs/ac of 26-18-5-3 dry blend fertilizer banded in the seed row below the seed shelf. Seed depth was targeted at 1.5" below the soil surface. Barricade II and Bison 400L were sprayed on the trial 16 days after seeding to control emerged broadleaf and grassy weeds. The trial was harvested on August 28, 2023, using CARA's Wintersteiger Classic small plot combine. All plots were bagged individually and later cleaned with a benchtop clipper screen shaker. Clean weights were reported and seed moisture was taken with the use of Dimo's Labtronics Model 919 moisture meter. One thousand seeds were counted out twice with the use of a Seedburo 801 Count-A-Pak and the average weight of the two counts was reported. Test weight was determined with the use of a 0.5L measure and converted to Avery bushel weight with the Canadian Grain Commission's conversion formula for Barley. A sub-sample from each plot was then taken and sent for protein analysis. Post harvest plant counts were taken by counting the number of plants in 1 meter of a center row of each plot and converted to plants/m^2. Data was then analyzed for statistical significance using SAS© OnDemand for Academics using the ANOVA procedure and Fisher LSD method for varietal mean differences with the REGWQ method to analyze seeding rate means.

Table 1 **Barley Seeding Rate Demo Treatments**

Treatment	Seeding Rate	Variety
TRT-1	20 seeds/sq foot	CDC Austenson
TRT-2	25 seeds/sq foot	CDC Austenson
TRT-3	30 seeds/sq foot	CDC Austenson
TRT-4	35 seeds/sq foot	CDC Austenson
TRT-5	20 seeds/sq foot	AAC Connect
TRT-6	25 seeds/sq foot	AAC Connect
TRT-7	30 seeds/sq foot	AAC Connect
TRT-8	35 seeds/sq foot	AAC Connect

Results

The 2023 growing season was characterized by moisture limitation and high temperatures (Table 2). Though the conditions were not ideal for the trial, results are outlined in Table 3. Analysis of clean yield showed that there was no significant difference between treatments. The results suggest that the two barley varieties respond differently to the tested seeding rates. AAC Connect had the highest yield result at the highest seeding rate, whereas CDC Austenson had the highest yield at 30 seeds/ft^2 (Table 3). The coefficient of variation (C.V.) for the yield data was determined to be 22.2%, which lowers the confidence in the data. Height and protein were not significantly affected by seeding rate or by variety (Table 3). There were significant differences between varieties AAC Connect and CDC Austenson in thousand kernel weight (TKW) and test weight. Average TKW for AAC Connect was found to be higher than the average TKW of CDC Austenson. Test weight response was opposite of TKW, CDC Austenson was found to have a significantly higher test weight over all seeding rates than AAC Connect. The seeding rate treatments had no significant effect on the TKW or test weight for either variety. Post harvest plant counts were found to vary significantly between varieties but also between seeding rate (Figures 2 and 3). CDC Austenson was found to have a greater average plant count than AAC Connect over all treatments (Figure 2). The greater seeding rates of 30 and 35 seeds/ft^2 resulted in significantly higher plant counts than for the 20 seed/ft^2 treatment. The three highest seeding rates were found to have no significant difference in plant counts (Figure 3).

Table 2: Weather data for Oyen growing season 2023 and long term average weather

Month	2023 Rainfall (mm)	Long Term Rainfall (mm)	Average Monthly Temperatures 2023 (°C)	Long-Term Monthly average Temperatures (°C)
May (24-31)	5.2	10.0	23.8	20.0
June (1-30)	13.6	75.5	25.5	21.6
July (1-31)	24.6	51.6	26.7	25.5
August (1-28)	16.5	39.8	26.2	25.4
Totals	59.9	176.9	25.6	23.1

Figure 1 **Plant Count Averages (m2) for CDC_Austenson and AAC Connect**

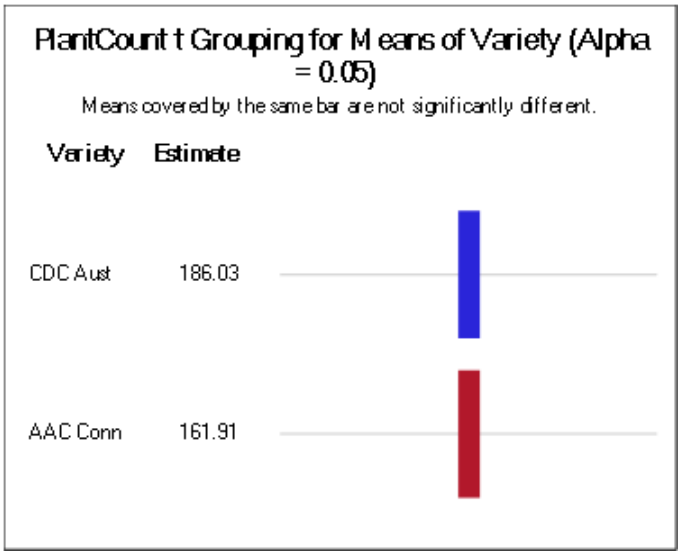


Figure 2 **Plant Count Averages (m^2) for the Four Seeding Rates Tested**

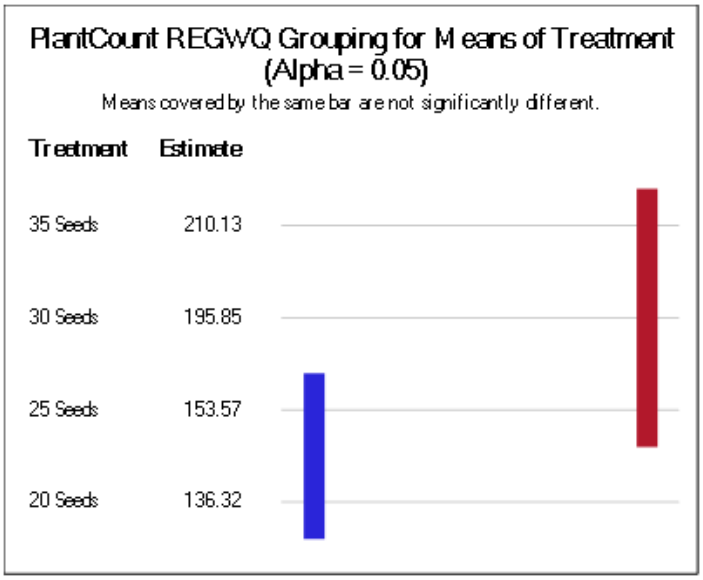


Table 3 **Yield and Quality Results from 2023 Trial**

Variety	Seeding Rate*	Plant Counts (per m2)	Moisture (%)	Yield (lb/A)	TKW (g)	Bu Wt (lbs)	Protein (%)	Height (cm)
CDC Austenson	20	150 b	12.3	1685.6	43.6	54.1	10.7	41.2
CDC Austenson	25	150 b	12.7	1559.6	43.6	54.2	10.9	37.8
CDC Austenson	30	195.2 a	13.4	1748.6	43.2	55.0	10.1	40.3
CDC Austenson	35	248.8 a	12.3	1440.2	42.8	54.2	10.1	36.2
Average		186.0 a	12.7	1608.5	43.3 b	54.4	10.4	38.9
AAC Connect	20	122.6 a	12.2	1419.8	44.4	53.3	10.9	40.5
AAC Connect	25	157.1 ab	13.1	1454.0	46.4	53.5	10.6	37.8
AAC Connect	30	196.4 a	12.9	1453.8	46.1	54.2	11.0	39.4
AAC Connect	35	171.4 a	12.0	1833.6	45.7	52.8	10.4	42.2
Average		161.9 b	12.6	1540.3	45.6 a	53.5	10.7	40.0
Trial Average		174.0	12.6	1574.4	44.5	53.9	10.6	39.4

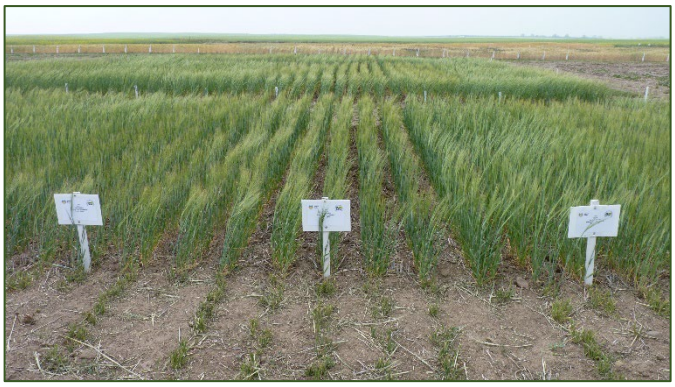
*seeds per square foot

Discussion

Weather conditions were not ideal during the 2023 growing season for plant development. Moisture was a limiting factor that caused high variability over the trial. Yield measurements between treatments were found not to be statistically significant for the trial, however some trends in the data could be perceived. The difference in yield averages between the two varieties could be attributed to the differences in genetics between CDC Austenson and AAC Connect. The breeding objectives for the two varieties could explain some of the yield difference, CDC Austenson was developed as a feed barley (Canadian Food Inspection Agency (CFIA), 2023a), whereas AAC Connect was developed to be a malting barley (CFIA, 2023b). CDC Austenson is reported as having fair to good tolerance to drought which could also contribute to the higher yield averages than AAC Connect based on the environmental conditions of the 2023 growing season (CFIA, 2023a). The differences in yield between the seeding rate treatments could suggest that the two varieties respond differently to intercrop competition. AAC Connect had the highest yield at 35 seeds/ft^2 suggesting that, under the conditions of 2023, the variety performed best with a higher plant density. CDC Austenson had the highest yield at 30 seeds/ft^2 and yield was reduced at 35 seeds/ft^2 which suggests that the variety performance increases as seeding rate increases until 30 seeds/ft^2 and is limited when the seeding rate is increased beyond 30 seeds/ft^2. The yield limiting beyond 30 seeds/ft^2 could suggest that, for CDC Austenson, intercrop competition could have a greater impact on yield than for AAC Connect. The differences between TKW and test weight between the varieties could be attributed to different breeding objectives between a feed barley and a malting barley. The lack of a significant difference between TKW and test weight over the 4 seeding rate treatments means that other conditions (i.e., weather, nutrient status, etc.) have a greater effect on the two grain quality measurements than seeding rate. Post-harvest plant counts suggested that target seeding rate impacts the number of plants that emerge. The data shows that as the target seeding rate increases, the number of plants/m^2 increases significantly. It was also found that the variety affected the number of plants that survive to maturity. This could be attributed to differing germination percentages between the two seed lots used in this experiment in addition to the genetic drought tolerance developed into CDC Austenson.

Conclusion

This study found that AAC Connect malting barley and CDC Austenson feed barley respond differently to differing seeding rates. AAC Connect responded positively to a higher seeding rate in terms of yield yet had an overall lower plant count than CDC Austenson. CDC Austenson appears to have plateaued at 30 seeds/ft^2 seeding rate and may be limited by higher seeding rates. Yield findings, however, were not significant in this study at the p=0.05 level. Grain quality measurements in this study suggest that seeding rate has little effect on test weight and kernel weight. Plant height and grain protein content were also found to be unaffected by the seeding rate or variety treatments. Other external factors are therefore likely the cause of grain quality and phenotypic differences. Further research into the yield and quality trends observed in this study of seeding rate should be undertaken. Data from this study is relevant to one growing season only and should be replicated in additional site years to determine validity of the findings.



At the site July 17

Jeremy Boychyn discussing barley seeding rates at CARA Field Day

References

McLelland, M., Panchuk, K., Green, B., Campbell, D., Harvey, B., Rossnagel, B., Foster, J., Kendall, N. (2009). *Malting barley.* Agri-Facts. Retrieved from: https://open.alberta.ca/dataset/7b3fa30b- f731-48ba-84be-87914a28580d/resource/dcc8978a-7882-4c91-add5- a68a92e8a10a/download/2009-114-20-2.pdf

Canadian Food Inspection Agency (CFIA). (2023a). *CDC Austenson.* Retrieved from: https://inspection.canada.ca/english/plaveg/pbrpov/cropreport/bar/app00007640e.shtml

Canadian Food Inspection Agency (CFIA). (2023b). *AAC Connect*. Retrieved from: https://inspection.canada.ca/english/plaveg/pbrpov/cropreport/bar/app00010044e.shtml