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Malting barley cultivar responses to increasing nitrogen rates in western Canada

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Background

- Approximately 60% of the barley grown in western Canada consists two-row malting cultivars, but only about 25% are deemed acceptable for malting annually
- Proper nitrogen (N) fertilization management remains a major challenge to optimizing malting barley yield and quality, and too high protein concentration (> 12.5%) can result in rejection for malting
- In recent years, AC Metcalfe has been the most widely grown cultivar followed by CDC Copeland
- However, several newer malting barley cultivars including CDC Meredith, Bentley and Merit 57 were recently shown to be superior to AC Metcalfe in terms of higher yields and lower protein concentration (O'Donovan et al. 2015)
- Several other malting barley cultivars are also available but have not undergone stringent assessment of their response to increasing N rates across the diverse climatic and edaphic regions of western Canada

Objective

The objective of this study was to to evaluate the relative agronomic responses (compared AC Metcalfe) of the malting barley cultivars AAC Synergy, CDC Kindersley, Cerveza and ABI Voyager when subjected to increasing N rates

Materials and Methods

- Field experiments were direct-seeded at Beaverlodge, Lacombe and Lethbridge, Alberta, Indian Head, Melfort and Scot, Saskatchewan, and Brandon, Manitoba in 2013 and 2014
- N (urea) was applied as a band (7.5 cm from seed) at four rates (0, 25, 50, and 100 kg/ha) at seeding
- The experiment was a randomized complete block with 4 replicates
- Data were analyzed using PROC MIXED of SAS with varieties and N rates as fixed effects, and environments (location-years), replicates and the environment interaction with fixed effects as random effects
- Since interactions were non-significant, regression analysis described the effects of N rate averaged across cultivars

Results

- The analysis of variance indicated highly significant ($p<0.001$) effects of N rate on all variables, and of cultivar on all variables except lodging ($P=0.058$); quadratic or linear responses to N were significant for all variables
- None of the interactions were significant, therefore the effects of the cultivars were similar regardless of N rate
- As expected, barley yield (Fig. 1) and protein concentration (Fig. 2) increased with increasing N rate
- AAC synergy produced the highest yield followed by ABI Voyager, Cerveza and CDC Kindersley, while AC Metcalfe produced the lowest yield (Table 1)
- ABI Voyager and AAC Synergy had the lowest protein concentration (Table 2)
- The effects of cultivar and N rate on the proportion of plump (Table 3; Fig. 3) and thin (Table 4: Fig. 4) kernels were minor, with the highest plump (Fig. 3) and lowest thins (Fig. 4) occurring at 25 and 50 kg/ha N
- AAC Synergy and ABI Voyager had a higher proportion of plump (Table 3) and lower proportion of thin (Table 4) kernels than the other cultivars
- Days to maturity increased with increasing N rate (Fig. 5), and ABI Voyager took the longest time to mature followed by Cerveza and AAC Synergy (Table 5)
- Lodging increased with increasing N rate (Fig. 6), and there was a strong trend ($P=0.058$) towards less lodging with Synergy, ABI Voyager and Cerveza compared to AC Metcalfe and CDC Kindersley (Table 6)

Conclusions

- The results indicate that the relatively new malting barley cultivars AAC Synergy and ABI Voyager have the potential to increase yields, reduce protein concentrations, produce more plump and less thin kernels, and possibly exhibit less lodging than the most widely grown cultivar, AC Metcalfe
- The superior agronomic characteristics of these cultivars may increase the likelihood that barley will be deemed acceptable for malting grade in western Canada
- The relatively late maturity of ABI Voyager, and to a lesser extent AAC Synergy, may be risky in the event of early fall frosts, especially in the more northerly regions with shorter growing seasons

Literature Cited

O'Donovan, J.T., Anbessa, Y., Grant, C.A., Macleod, A.L., Edney, M.J., Turkington, T.K., Juskiw, P.E., May, W.E., Harker, K.N., Johnson, E.N., Beres, B.L., McAllister, T.A., and Chapman, W. (2015). Relative responses of new malting barley cultivars to increasing nitrogen rate in western Canada. Can. J. Plant Sci. 95:831-839.

Table 1. Effect of cultivar (averaged across N rates) on yield

Cultivar	Yield (t/ha)
AC Metcalfe	4.35 C
AAC Synergy	4.86 A
CDC Kindersley	4.55 B
ABI Voyager	4.64 B
Cerveza	4.59 B

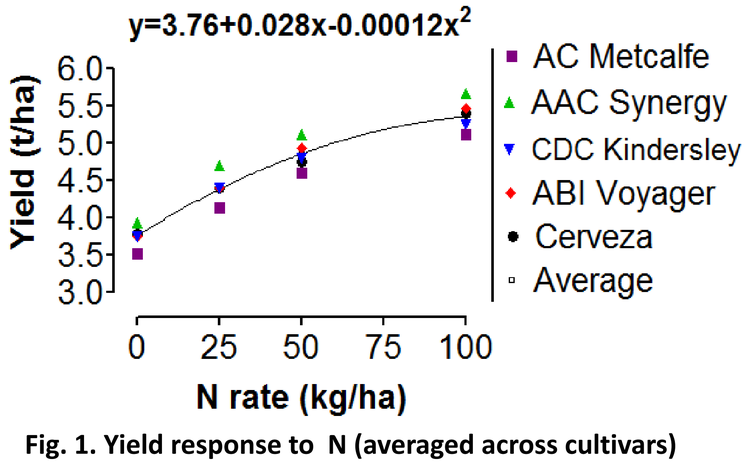

Fig. 1. Yield response to N (averaged across cultivars)

Table 2. Effect of cultivar (averaged across N rates) on protein

Cultivar	Protein (%)
AC Metcalfe	11.9 A
AAC Synergy	11.7 B
CDC Kindersley	11.9 A
ABI Voyager	11.4 B
Cerveza	11.8 A

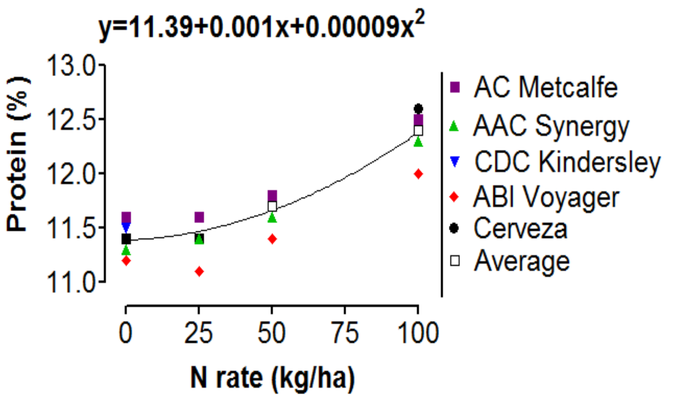

Fig. 2. Protein response to N (averaged across cultivars)

Table 3. Effect of cultivar (averaged across N rates) on kernel plump

Cultivar	Plump (%)
AC Metcalfe	93 BC
AAC Synergy	96 A
CDC Kindersley	94 B
ABI Voyager	96 A
Cerveza	93 C

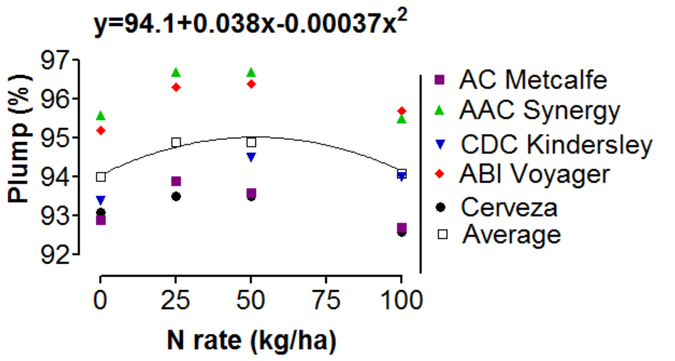

Fig. 3. Plump response to N (averaged across cultivars)

Table 4. Effect of cultivar (averaged across N rates) on kernel thins

Cultivar	Thins (%)
AC Metcalfe	1.19 A
AAC Synergy	0.635 B
CDC Kindersley	1.27 A
ABI Voyager	0.672 B
Cerveza	1.13 A

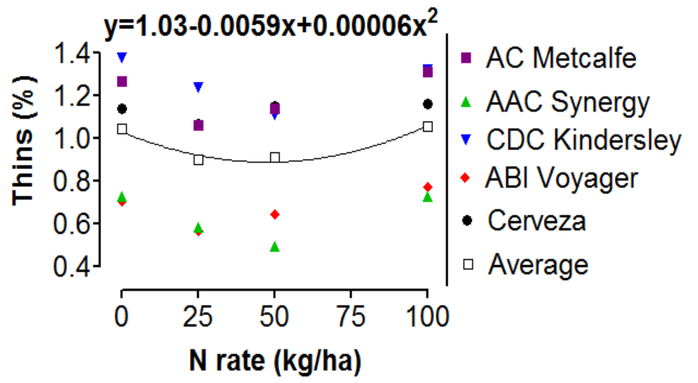

Fig. 4. Thins response to N (averaged across cultivars)

Table 5. Effect of cultivar (averaged across N rates) on kernel maturity

Cultivar	Maturity (days)
AC Metcalfe	95.0 C
AAC Synergy	96.3 B
CDC Kindersley	94.5 C
ABI Voyager	97.3 A
Cerveza	97.0 AB

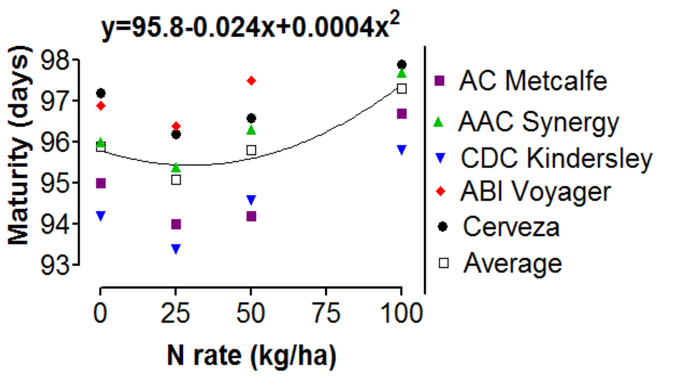

Fig. 5. Maturity response to N (averaged across cultivars)

Table 6. Effect of cultivar (averaged across N rates) on lodging

Cultivar	Lodging (0-2)
AC Metcalfe	0.738 A
AAC Synergy	0.454 B
CDC Kindersley	0.567 AB
ABI Voyager	0.426 B
Cerveza	0.439 B

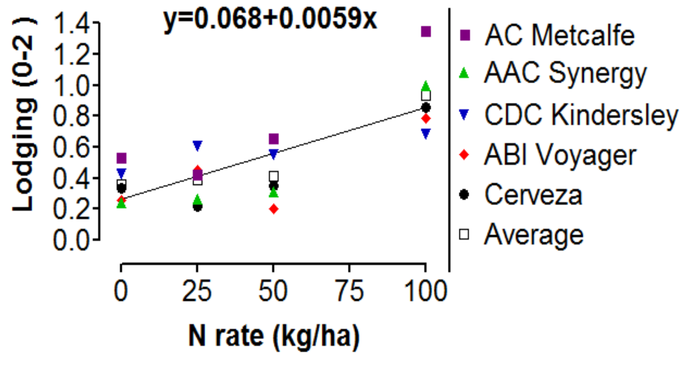

Fig. 6. Lodging response to N (averaged across cultivars)

Acknowledgments

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