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Effect of seed source on malting quality and yield of malting barley

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Introduction

- Canada is an important producer of feed and malting barley, while also exporting malt barley grain and finished malt
- Recent malt barley agronomic research has indicated that crop production factors can be fine-tuned to improve malt barley productivity and quality (O'Donovan et al. 2011; Turkington et al. 2012)
  - Overall, western Canadian farmers have the knowledge, experience, and tools to sustainably produce high quality feed and malting barley
- In western Canada barley faces significant competition for acres from crops including canola, wheat, and pulses
  - Commodity prices for these other crops can make them attractive alternatives to barley
- However, familiarity with growing malt barley, and lower production costs and resulting increased net returns can influence a farmer's cropping choices
  - Farmers are interested in lowering input costs, hopefully without negatively impacting crop productivity and grain quality
    - Expenses associated with malt barley seed used for planting can be a target for farmers looking at reducing input costs
    - Some farmers will purchase slightly higher priced certified seed, but then reuse harvested grain from the resulting crop for planting the following year
- Acceptance standards for malting barley focus on varietal purity, high and vigourous germination, and clean sound uniform grain
  - Any practice that may impact these standards is of concern
  - Farmers wanting to reuse farm-saved barley seed may inadvertantly compromise the potential for malt selection and malting quality of the grain they produce

Objectives

- To assess the impact of certified versus bin run seed on barley productivity, and barley and malt quality

Materials and Methods

- To assess the impact of seed source, field trials were conducted at 7 locations across western Canada from 2010-2011
  - Alberta: Fort Vermilion (2010/2011), Beaverlodge (all years), Lacombe (all years), and Lethbridge (2011/2012)
  - Saskatchewan: Scott (all years) and Indian Head (all years)
  - Manitoba: Brandon (2010/2012)
- Experimental design and data collection
  - 4 replicate RCBD with a comparison of seed source (certified or bin run) nested within three areas where barley was sourced from (Red Deer, Three Hills, and Camrose, Alberta).
  - The variety used was the 2-row malting barley cv. AC Metcalfe
  - Crop yield and kernel characteristics (e.g. thousand kernel weight, plumps, etc.) were assessed on a per plot basis
  - Constraints on malting capacity and quality analysis limited the number of locations that could be malted and analysed each year
    - In 2010 four replicates of the treatment combinations from Beaverlodge and Brandon, and three replicates of the treatment combinations from Indian Head and Scott in 2011 and Lacombe and Lethbridge in 2012 were malted across the six location/years with a total of 120 samples malted and analysed for quality
  - 2 kg subsamples of harvested barley grain from each plot were sent to the GRL CGC for assessment of malting quality
    - Dry barley was stored after harvest under warm (20°C) dry conditions which stabilized moisture contents
    - Barley was tested for grain protein content, germination energy (4 ml and 8 ml) and plumpness (American Society of Brewing Chemists, 2004)
    - Plump barley (screened over 2.38 mm slotted sieve) was malted (500 g) using a Phoenix Automated Micromalting machine (Adelaide, SA, Australia) according to a standard commercial-like schedule
    - Malt analyses were performed according to the standard methods of the American Society of Brewing Chemists (2004)
  - Data were analyzed using PROC MIXED of SAS
    - Seed source considered as a fixed effects, while area was random
    - Location by year combinations (environments) and their associated interactions with fixed effects were considered random effects, as were replicates nested within environments
    - Effects of seed source nested within area declared significant at $p < 0.05$

Results

- The impact of seed source on productivity, and barley and malting quality
  - No significant differences were detected between certified and bin run seed for the following productivity and kernel quality variables (Figure 1a-b):
    - Grain yield and thousand kernel weight
    - Emergence, test weight, percentage plumps and percentage thins (data not shown)
  - Seed source did not significantly affect barley quality (data not shown) for the following variables
    - Kernel colour, weight and diameter, variability in kernel diameter, grain protein, germinative energy or water sensitivity
  - Seed source did not significantly affect malting quality (Figures 2a-d and 3a-d) for the following variables
    - Steepout moisture, Kolbach index, friability, wort ß-glucan, malt extract, wort colour, diastatic power, α-amylase, and Calcofluor homogeneity (data not shown)

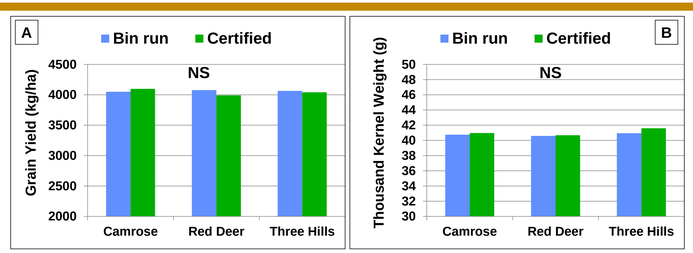

Figure 1. Effect of seed source (bin run versus certified) on: a) grain yield; and b) thousand kernel weight averaged over 18 sites (location by year combinations) distributed across the Prairies, 2010-2012. NS = no significant effect of seed source (certified versus bin run) nested within source area.

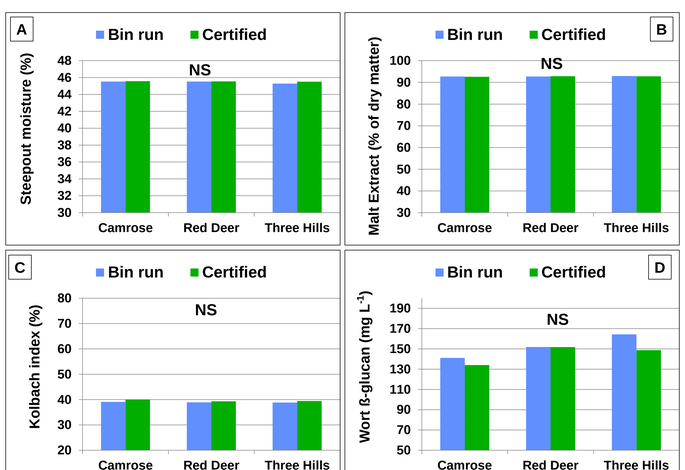

Figure 2. Effect of seed source (bin run versus certified) on: a) steepout moisture; b) malt extract; c) Kolbach index; and d) Wort ß-glucan averaged over six sites (location by year combinations) distributed across the Prairies, 2010 - 2012. NS = no significant effect of seed source (certified versus bin run) nested within source area.

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Figure 3. Effect of seed source (bin run versus certified) on: a) diastatic power ; b) wort colour ; c) α-amylase ; and d) friability averaged over six sites (location by year combinations) distributed across the Prairies, 2010 - 2012. [z] degrees Lintner. [y] Dextrinizing units. NS = no significant effect of seed source (certified versus bin run) nested within source areas

Conclusions

- Seed source, i.e. certified versus bin run AC Metcalfe did not significantly affect field performance, and barley and malt quality
  - The nature of the bin run seed was likely responsible for limited differences in barley productivity, and barley and malt quality observed from 2010-2012
    - Certified seed was originally from seed growers, while in contrast bin run seed was sourced from farmers supplying malt barley to Rahr Malting, Inc. and was only one year away from certified
    - Seed sourced from malt barley farmers was also typically from grain that had attained malting status from Rahr Malting, Inc., and thus would be expected to be of good quality with high levels of germination
    - It is expected that bin run seed from other sources, and where it is more than one year away from certified, would have much different quality, and would likely have more pronounced negative effects on barley productivity, acceptance for malt status, and barley and malting quality
  - Certified seed use by malt barley farmers is still strongly encouraged as it limits risk to production and quality, while increasing the potential for malt selection and ensuring the quality of the maltster's final product

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