Optimal seeding rate based on seed size in canola

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Introduction

- Canola Council recommends seeding at a rate to achieve **target plant population** of 7-10 plants/ft²
  - Canola achieves 90% of yield potential at 4-5 plants/ft² (Shirtliffe & Hartman 2009)
  - Recommendation allows for in-season stresses

- **Seed size** (thousand seed weight, TSW) differs significantly among seed lots in canola
  - Range from lower than 3 g/1000 seeds to over 6 g/1000 seeds

- **Emergence rates** differ significantly with management and environmental conditions
  - Approximate range 50-70%
Introduction

- Considering range in seed size and emergence rates, weight per unit area seeding rates required to achieve the recommended target plant population can vary significantly.

- In addition, canola emergence and yield have been shown to be affected by both seeding rate and seed size in canola.

<table>
<thead>
<tr>
<th>Seed size (g 1000 seeds⁻¹)</th>
<th>Target density (plants ft⁻²)</th>
<th>Emergence rate (%)</th>
<th>Seeding Rate (seeds ft⁻²)</th>
<th>Seeding Rate (lb/ac)</th>
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Seeding rate effect

- Plant mortality (in-season thinning) increased with seeding rate - Harker et al 2017.
- Greater spring plant density with seeding rate; Emergence rate, survival rate & yield did not differ between two seeding rates - Harker et al 2015.
- No influence of seeding rate on yield - Kutcher et al 2013

- Emergence rates vary with management and environment - yield response to seeding rate dependent on actual seeding rates used in each trial combined with emergence rate and resulting plant population.
Seed size effect

- Larger seed increased crop density and decreased plant mortality; Seed size by seeding rate interaction with yield - smaller seed improved canola yield at higher seeding rates, but same response not seen with larger seed - Harker et al 2017.
- Larger canola seed produces larger seedlings and higher yields (due to resilience of larger seedlings to flea beetles) - Elliot et al 2008.
- Emergence and yield benefit with larger canola seed - Brill et al 2016.

- Inconsistent results have been attributed to different seed sizes that were compared, in addition to variability in environmental conditions.
Objectives

1) Determine optimal seeding rate to achieve adequate plant populations and optimize yield under various environmental conditions in Saskatchewan.

2) Determine if optimum seeding rate varies across hybrids or with seed size.
Methods

- Randomized split-plot:
  - Main plot = Hybrid (L233P or 45M35)
  - Subplot = Seed size (“small” or “large”) x Seeding rate (5, 10, 15 seeds ft^{-2})
    - Actual TSWs:
      |       | Small | Large |
      |-------|-------|-------|
      | L233P | 4.3 g | 5.5 g |
      | 45M35 | 4.8 g | 5.9 g |
  - 5 sites in 2018: Indian Head, Melfort, Scott, Outlook, Yorkton
    - Same 4 seed lots used at each site
Statistical Analysis

Mixed effect models - for each response variable:
- Fixed effects: Seeding rate, Seed size, Hybrid, and all 2- and 3-way interactions
- Random effects: Hybrid within Block within Site

Model simplification process
- Non-significant fixed effects dropped from the model one at a time, starting with higher-order interactions, as long as it doesn’t result in significantly greater deviance in the model.
- Final model includes only significant effects.
Spring plant density

Seeding rate: $P < 0.0001$

Hybrid: $P = 0.033$
Emergence rate

![Graph showing the relationship between seeding rate and percent establishment for large and small seed sizes. The graph includes error bars and statistical significance levels.]

Seed Size: P=0.027
Seeding Rate: P=0.002
**Fall stubble density**

![Graph showing the relationship between seeding rate and fall plant density.](image)

- **Seed Size:** $P=0.0001$
- **Seeding Rate:** $P<0.0001$
- **Rate x Hybrid:** $P=0.043$
Percent survival

Seed Size: $P=0.001$
Seeding Rate: $P<0.0001$
Hybrid: $P=0.002$
Days to maturity

Days to Maturity

Seeding rate (seed m$^{-2}$)

Seeding rate: $P = <0.0001$

Hybrid: $P = <0.0001$
Yield

Seeding rate (seeds m\(^{-2}\))

Seed Size: P=0.012
Seeding Rate: P=0.044
Conclusions & Recommendations

- Seeding rate effect on all response variables examined
  - No interaction with seed size; interaction with hybrid only for fall plant density.
  - Optimum plant population achieved at 10 seeds ft\(^{-2}\) rate for all seed sizes and hybrids, but emergence rates were excellent at all locations in 2018 - responses may differ when emergence rates are lower.

- Seed size was influential on many response variables, but is sometimes secondary to effect of hybrid.

- Site was a significant random effect in all models - indicates differing response among environments - could be explored further with site as a fixed effect.

- Emergence rates and resulting plant populations are important considerations when assessing seeding rate and seed size effects on canola productivity - should be monitored over several seasons to be able to better calculate accurate seeding rates to achieve optimal plant populations.
Acknowledgements

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