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

Seed size (g 1000 seeds^{-1})	Target density (plants ft^{-2})	Emergence rate (%)	Seeding Rate (seeds ft^{-2})	Seeding Rate (lb/ac)
3	7	50	14	**4.0**
3	7	60	12	**3.4**
3	7	70	10	**2.9**
4	7	50	14	**5.4**
4	7	60	12	**4.5**
4	7	70	10	**3.8**
5	7	50	14	**6.7**
5	7	60	12	**5.6**
5	7	70	10	**4.8**
6	7	50	14	**8.0**
6	7	60	12	**6.7**
6	7	70	10	**5.7**

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
- Canola yield increases with plant population - Yang et al 2014, Harker et al 2012, Hanson et al 2008, Brandt et al 2007.

- 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.
- Lack of emergence or yield benefit with larger seed size – Harker et al 2015, Clayton et al 2009, Lamb & Johnson 2004.

- 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:

L233P	Small	4.3 g
	Large	5.5 g
45M35	Small	4.8 g
	Large	5.9 g

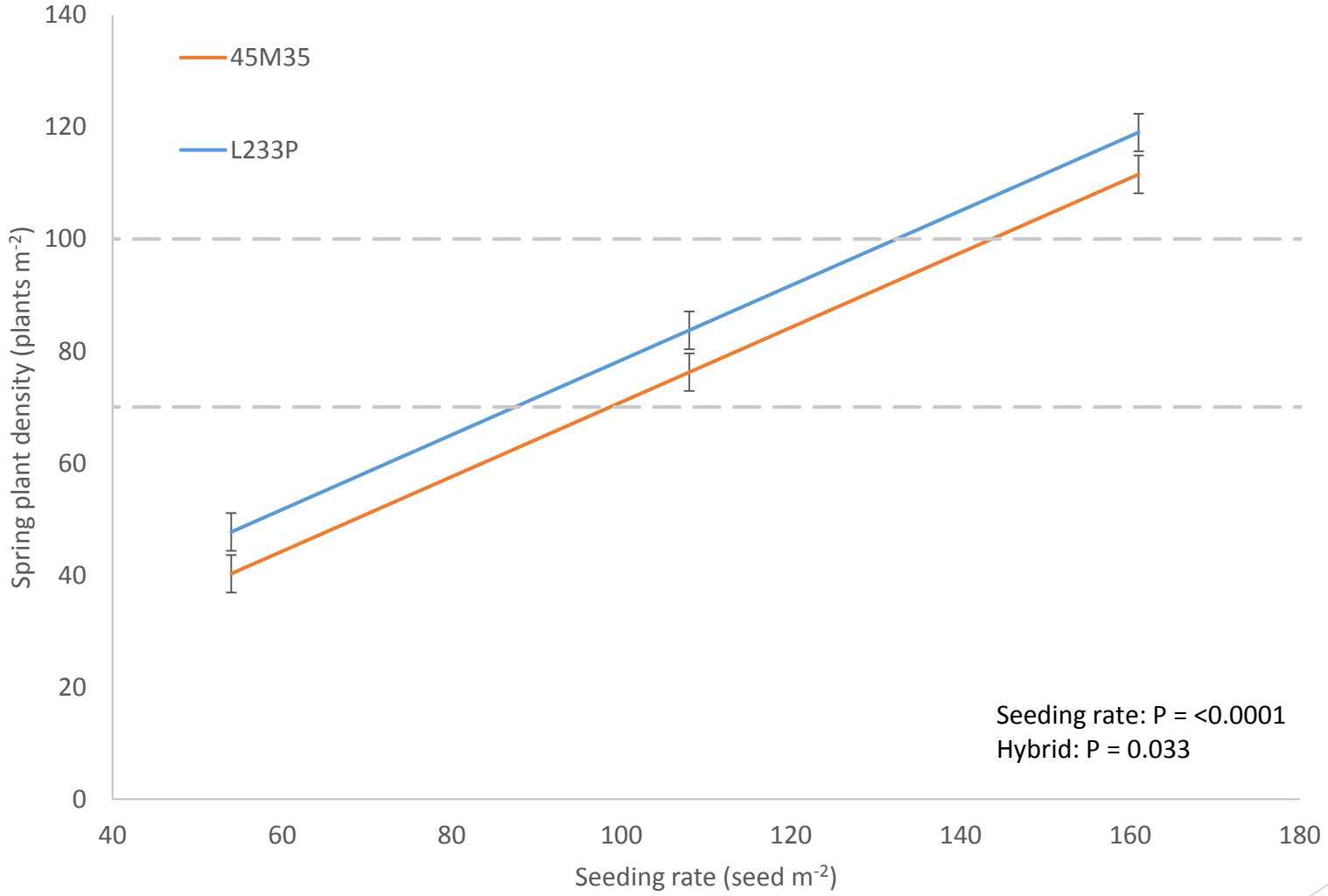
- 5 sites in 2018: Indian Head, Melfort, Scott, Outlook, Yorkton
  - Same 4 seed lots used at each site

Statistical Analysis

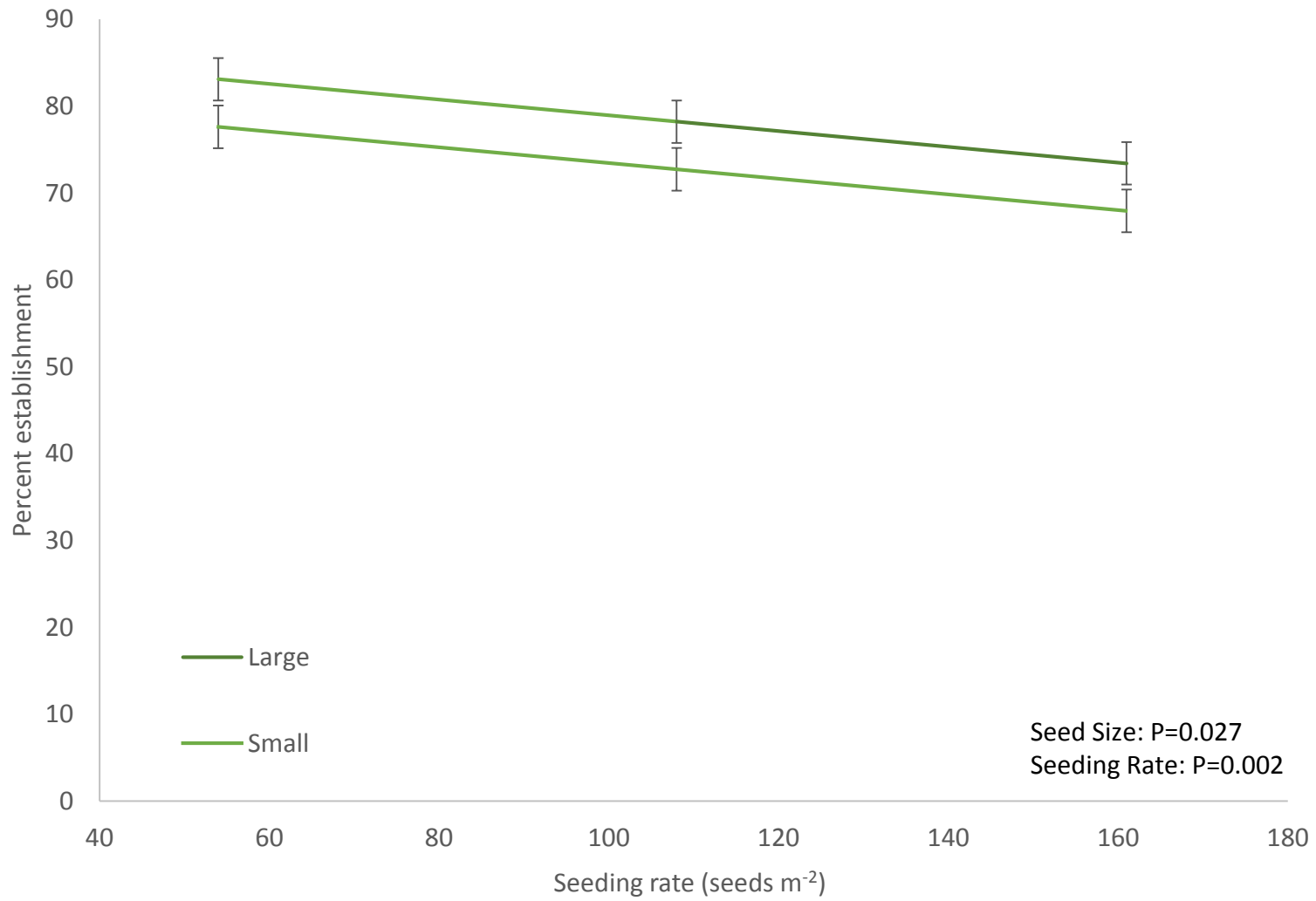
- Mixed effect models – for each response variable:
  - Fixed effects: Seeding rate, Seed size, Hybrid, and all 2- and 3-way interactions
  - Random effects: Hybrid within Block within Site

- 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.

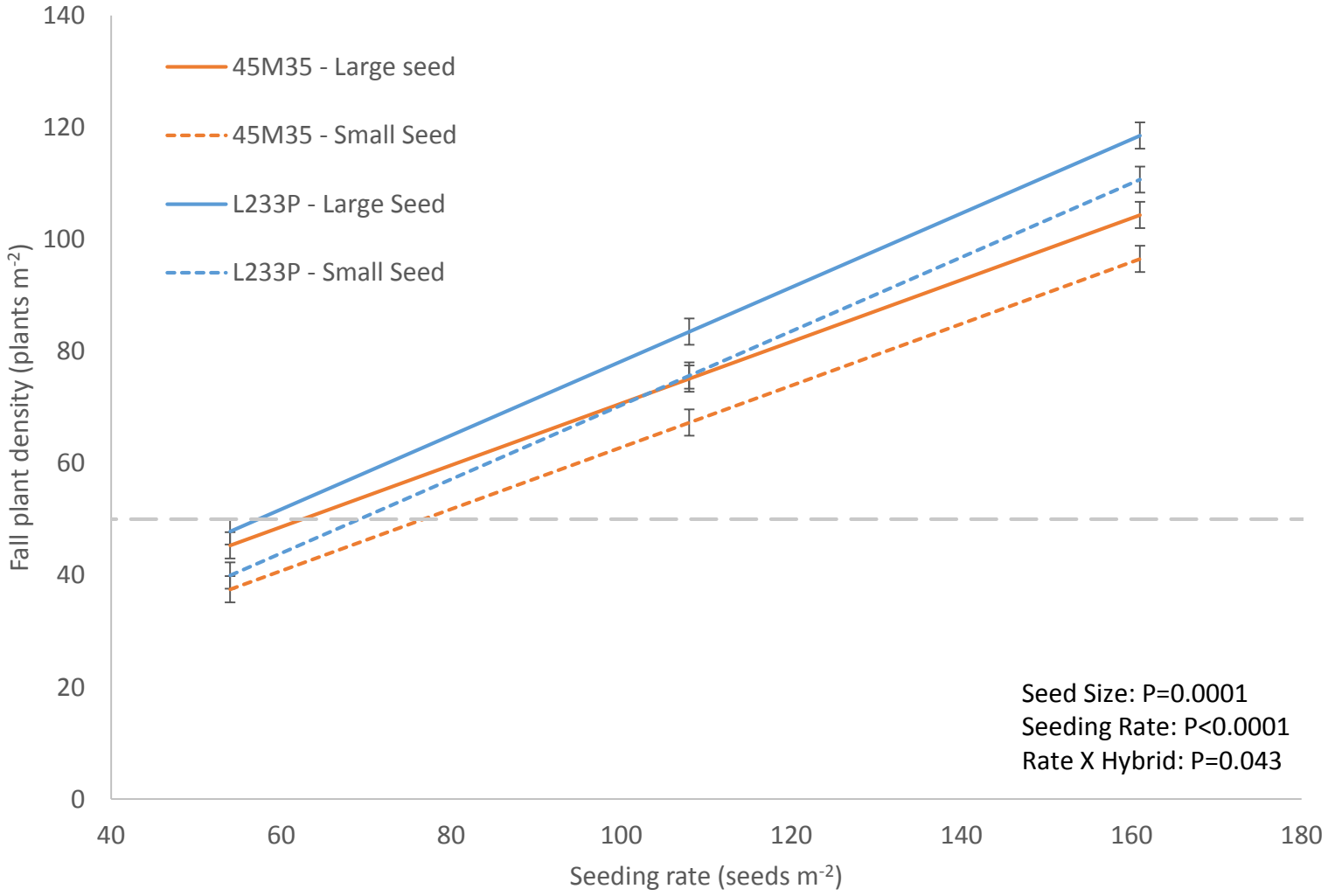
Spring plant density



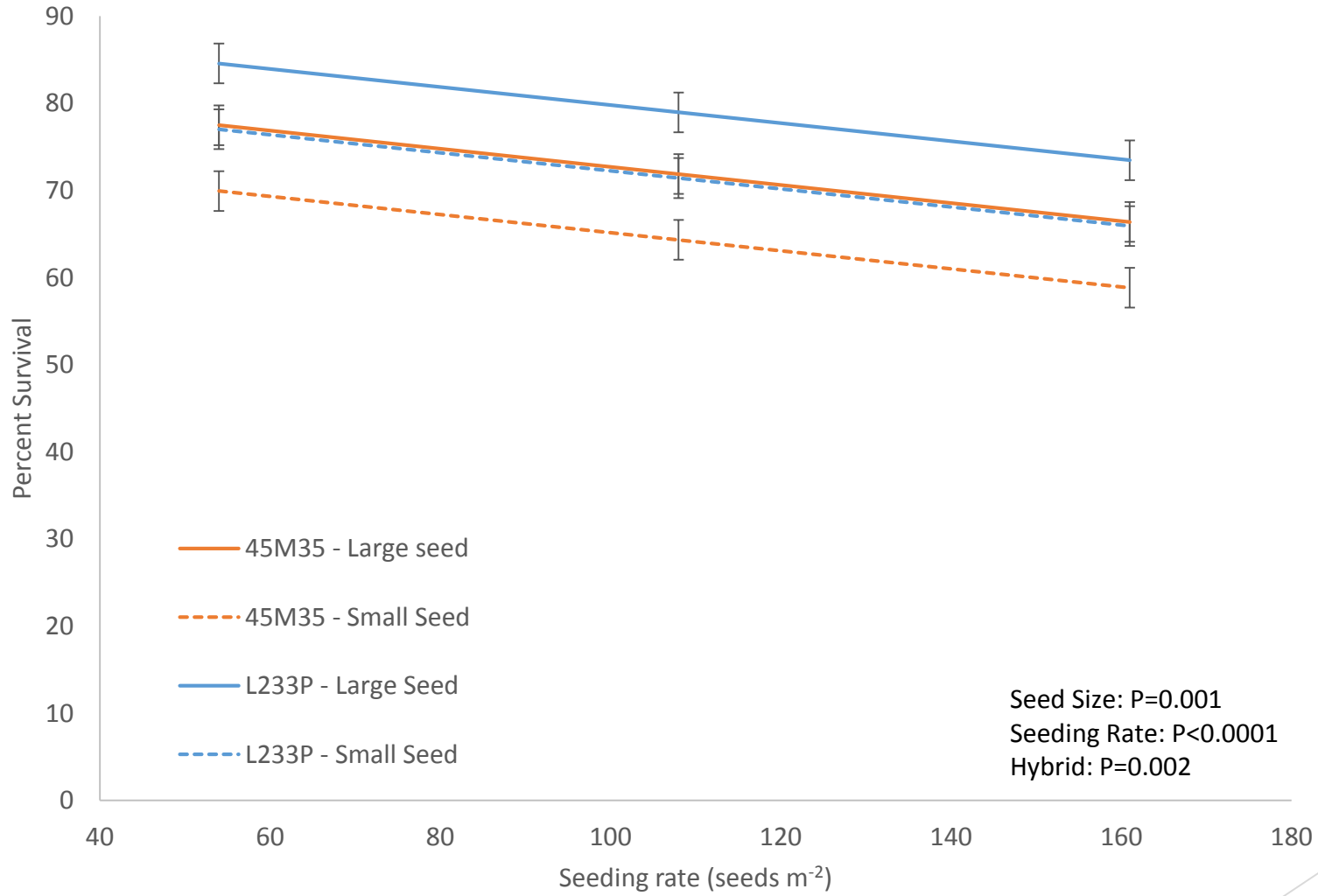
Emergence rate



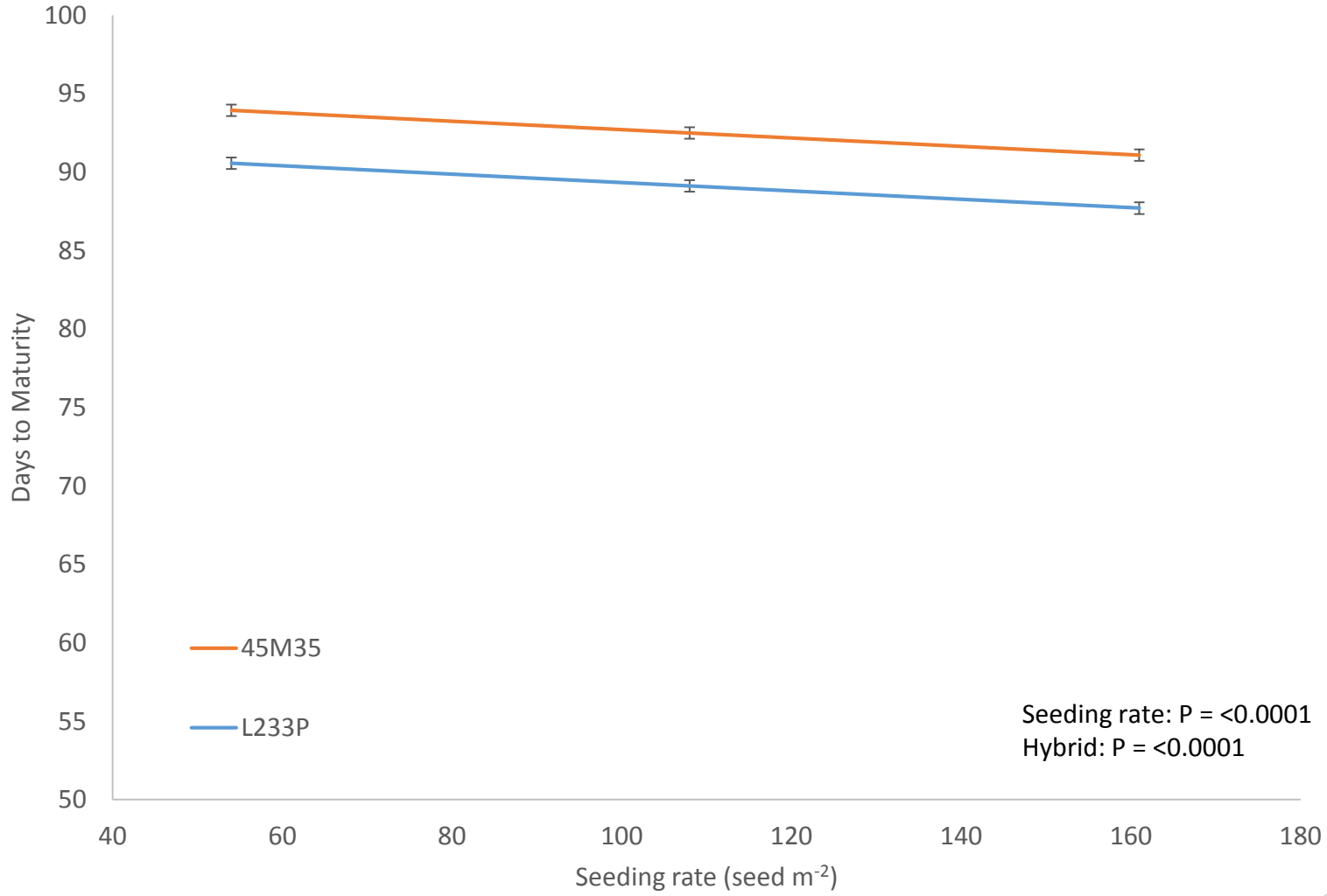
Fall stubble density



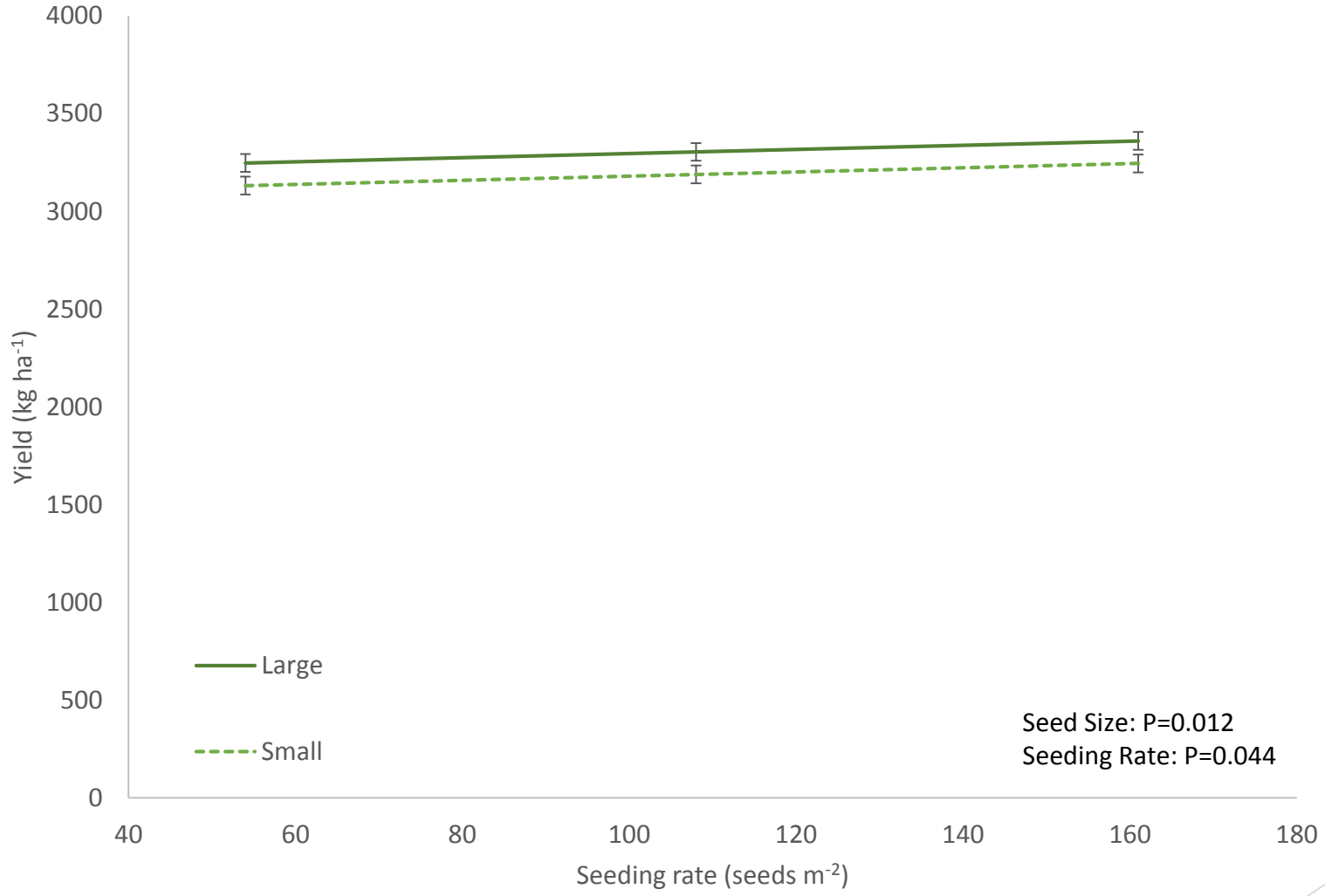
Percent survival



Days to maturity



Yield


4000
3500
3000
2500
2000
1500
1000
500
0
Yield (kg ha-1)
40
60
80
100
120
140
160
180
Seeding rate (seeds m-2)
Large
Small
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.

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