TRIAL LOCATIONS 2019: Miling and Kojonup, Western Australia

TITLE:

Trial 2: The interaction between seeding rate and seed size of hybrid and open pollinated canola (*Brassica napus*) varieties on annual ryegrass (*Lolium rigidum*) growth and competition.

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ABSTRACT

Trials located at Miling and Kojonup in the grainbelt of Western Australia investigated combinations of canola variety (hybrid or open pollinated), canola seeding rate (20, 35 or 50 plants/m^2) and canola seed size (<1.8, >2.0mm diameter). The average seedbanks at the Miling and Kojonup sites were 3,410 seeds/m^2 and 25,305 seeds/m^2 respectively. Annual ryegrass (ARG) establishment was reduced in hybrid canola treatments, treatments with increased seed size and higher seeding rates. However, no interaction between these factors existed. At the Kojonup site, ARG seed production was reduced by hybrid varieties (Trophy). Due to the low rainfall at the Miling site, no interaction between treatments were identified. Canola yield in this study was increased in the hybrid variety (Trophy) treatments especially at higher seeding rates (50 plants/m^2). In the absence of ryegrass, increased canola seed size also increased canola yield. This study conducted two trials in 2018 (Mingenew and Cunderdin) and 2019 (Miling and Kojonup). Multi- environment trial analysis for the combined 2018 and 2019 data to be completed.

INTRODUCTION

Canola is the most widely grown broadleaf crop in Australia since its introduction in 1969 (Angus et al., 2015; Colton & Potter, 1999) due to its profitability and rotational benefits to the successive crops (Seymour, Kirkegaard, Peoples, White, & French, 2012). Past research has demonstrated the link between developing sufficient vegetative biomass before anthesis and canola yield potential (McCormick, Virgona, & Kirkegaard, 2012; Robertson, Holland, & Bambach, 2004). Biomass produced at anthesis has been shown to be affected by sowing date, cultivar choice (Robertson et al., 2004), N rate (Hocking & Stapper, 2001) and plant population (Brandt et al., 2007). In Australia however, Brill et al (2016) demonstrated that seed characteristics such as seed size were also major determinants of anthesis biomass due to its effect on improving canola establishment and early biomass accumulation in both hybrid and open-pollinated cultivars. It is expected that any improvement in canola establishment and early biomass accumulation leading to increased biomass at anthesis will improve the crops competitiveness against weeds and reduce weed seed production. The objective of this study is to determine the optimal combinations of canola cultivar, seeding rate and seed size on annual ryegrass seed production and canola growth and yield.

Methods

Trial design: Randomised complete block

Replicates: 3

Locations (2): Miling and Kojonup in the Western Australian grainbelt.

Seed size (2): <1.8mm and >2.0mm in diameter

Seed rate / plant establishment target (3): 20, 35 and 50 plants/m^2

Variety (2): Trophy (Hybrid) and Bonito (Open pollinated).

Herbicide treatment (2): Without (Knockdown treatment only) and with (1 L/ha Propyzamide IBS, 1.1 kg/ha Atrazine IBS, 1.1 kg/ha Atrazine 2-4 leaf and 500 mL/ha Select 4-6 leaf).

Trial Management

Table 1 Trial management details.

Date sown	Miling 03 May 2019 and Kojonup 14 May 2019
Crop type	TT Canola
Variety	Trophy (Hybrid) and Bonito (OP)

Seeding rate (kg/ha)	Trophy<1.8 mm Recommended 1.8 kg/ha Trophy<1.8 mm 70% 1.3 kg/ha Trophy<1.8 mm 40% 0.7 kg/ha Trophy>2 mm Recommended 4.3 kg/ha Trophy>2 mm 70% 3.0 kg/ha Trophy>2 mm 40% 1.7 kg/ha Bonito <1.8 mm Recommended 1.9 kg/ha Bonito <1.8 mm 70% 1.3 kg/ha Bonito <1.8 mm 40% 0.8 kg/ha Bonito >2 mm Recommended 3.3 Bonito >2 mm 70% 2.3 kg/ha Bonito >2 mm 40% 1.3 kg/ha	
Tillage type	Minimum tillage	
Soil moisture, depth (cm)	Poor	>5
Seed bed	Standing Stubble	
Clod size	None	
Stubble loading	10-20%	
Sowing equipment	Knife points and press wheels	
Sowing speed (km/hr)	5	
Sowing depth	1 cm	
Row spacing (cm)	25 and 50	
Fertiliser applied	Pre-emergent	100 kg/ha Gusto Gold 50 kg/ha Urea
	Post-emergent	40 L/ha UAN 100 L/ha UAN
Herbicides applied	Pre-emergent	1.2 L/ha Roundup Ultra Max 150 mL/ha Lontrel Other pre-em herbicides as per treatment list
Post-emergent	As per treatment list 3 L/ha Roundup Ultra Max (02/10/2018)	
Fungicides applied	Seed treatment	400 mL/100kg-seed Maxim XL
Fertiliser treatment	300 mL/ha Impact	
	Post-emergent	150 mL/ha Prosaro
Insecticides applied	Seed treatment	1 L/100kg-seed Cruiser Opti
Pre-emergent	1 L/ha chlorpyrifos 200 mL/ha bifenthrin	
Post-emergent	50 g/ha Transform 300 mL/ha Affirm	

The data collected during the 2019 growing season was analysed using an analysis of variance in Genstat v15.

LOCATIONS

The soil characterization for Miling (-30.29S, 116.22E) and Kojonup (-33.84S, 117.15E) in the Western Australian grainbelt can be found in Table 2. The long-term (19 years) average growing season (April to October) rainfall at Miling and Kojonup was 242 mm and 383mm respectively. Prior to this study, all sites had been under continuous no-till crop production for 10 years.

Kojonup 2019

The Kojonup site (Figure 3) had an estimated annual ryegrass seed bank of 25,305 seeds/m^2 in the top 10cm of the soil. The site was seeded in good soil moisture due to good rainfall in late March, so we had rapid crop emergence. Following seeding, there was no subsequent rainfall until June were excellent rainfall was recorded in late July and mid-August eliminating water stress from this trial (Figure 1).

Miling 2019

The Miling site (Figure 4) had an estimated annual ryegrass seed bank of 3,410 seeds/m^2 in the top 10cm of soil. The site was seeded in dry with limited rainfall (<10mm) in March (3 weeks before seeding). As a result, the trial was seeded into dry soil. Canola germination and emergence at the Miling site did not occur until June when 87 mm fell in the month (Figure 2). Rainfall events occurred in July and August; however, conditions were cold limiting growth. The final rainfall occurred in October (Figure 2).

Table 2 Soil description at the Miling and Kojonup experimental sites in 2019.

		Milling	**Kojonup**
	Depth (cm)	**0-10**	**0-10**
Colour		LTGR	DKGR
Gravel	%	0	0
Texture		1.5	2.0
Conductivity	dS/m	0.127	0.122
pH Level (CaCl2)		6.0	5.9
pH Level (H2O)		6.8	6.6
Exc. Aluminium	meq/100g	0.073	0.097
Exc. Calcium	meq/100g	3.51	9.26
Exc. Magnesium	meq/100g	0.85	1.06
Exc. Potassium	meq/100g	0.30	0.24
Exc. Sodium	meq/100g	0.08	0.09
Total Carbon	%	1.69	4.33
ECEC	meq/100g	4.8	10.7
Organic Matter	%	3.23	6.62
Organic Moisture %	%	1.0	6.2
MIR% Clay	%	22.30	22.30
MIR% Sand	%	74.80	75.00
MIR% Silt	%	2.90	2.70

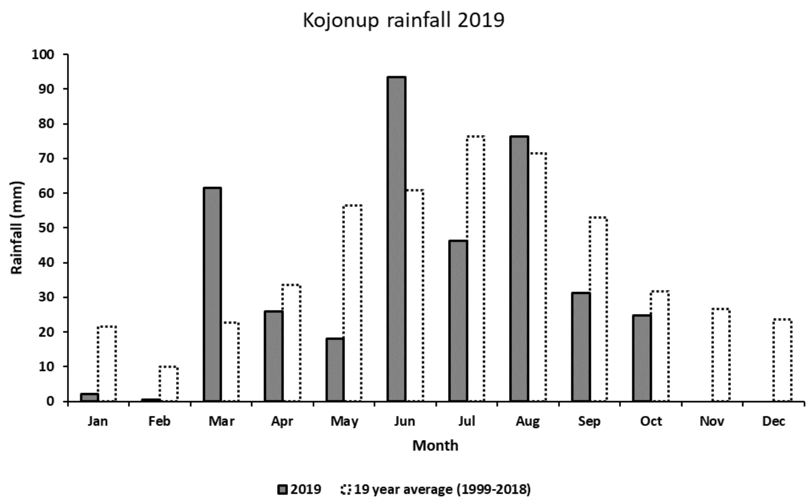

Figure 1: Kojonup site rainfall in 2019.

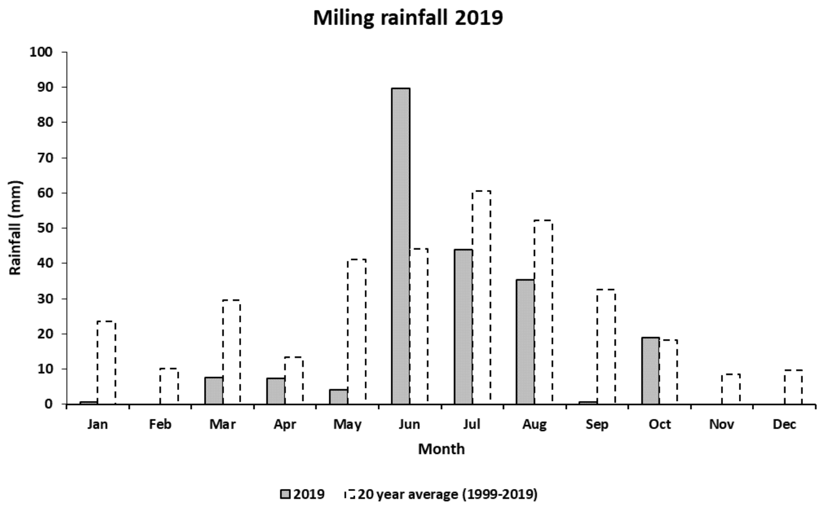

Figure 2 Miling site rainfall in 2019.

Figure 3 Aerial photos of the Kojonup trial site in 2019.

Figure 4 Aerial photos of the Miling trial site, located within the Leibe group technical development field day site in 2019.

RESULTS AND DISCUSSION.

KOJONUP 2019

ARG EMERGENCE

At the Kojonup site in 2019, no significant interactions were found between pollination type (Hybrid or OP) and canola seeding rate or canola seed size (P>0.05). However, this study found that the open pollinated variety (Bonito) had greater ARG establishment compared to the hybrid variety (Trophy) (P<0.001). Smaller seed size (<1.8mm) had a slightly higher ARG establishment rate than large seeded canola (>2.0mm) (P=0.039). The increasing seed rate treatment also reduced ARG establishment (P=0.004) (Figure 5).

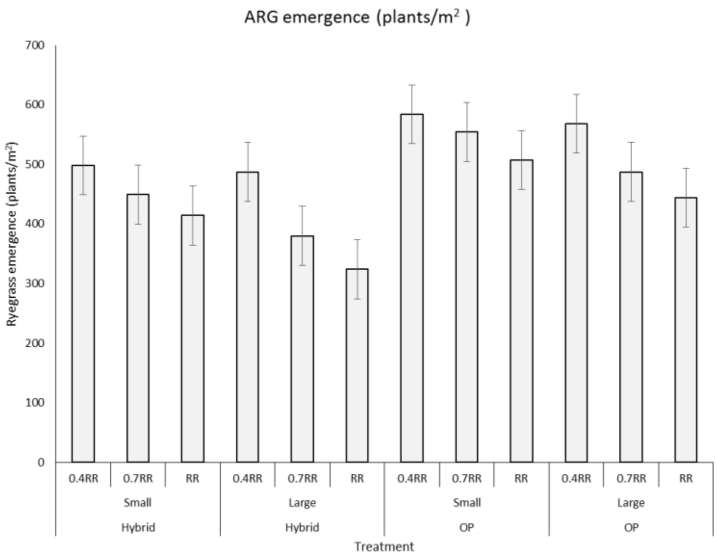

Figure 5 Annual ryegrass emergence at the Kojonup site in 2019.

ARG SEED PRODUCTION

At the Kojonup site in 2019, no significant interactions in ARG seed production were found between pollination type (Hybrid or OP) and canola seeding rate or canola seed size (P>0.05). ARG seed production was however affected by pollination type with the hybrid variety (Trophy) consistently having less ARG seed production compared to open pollinated (Bonito) treatment (P<0.001) (Figure 6).

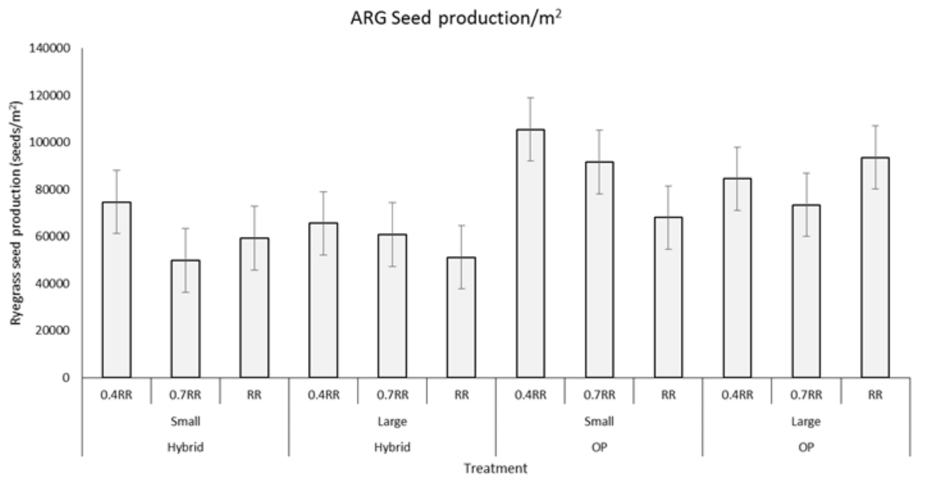

Figure 6 Annual ryegrass seed production at the Kojonup site in 2019.

CANOPY COVER

The early competitive ability of the canola treatments was demonstrated in the canopy cover (%) measured at 9WAE. Results indicate that there was no significant interactions in percent canopy cover found between pollination type (Hybrid or OP) and canola seeding rate or canola seed size (P>0.05). Canopy cover was however affected by pollination type with the hybrid variety (Trophy) consistently having greater canopy cover compared to open pollinated variety (Bonito) treatments (P<0.001). Canola seed size consistently increased canopy cover (P<0.001). Increasing the canola seeding rate from 20 to 50 plants/m^2 was also found to increased canopy cover (P<0.001) (Figure 7).

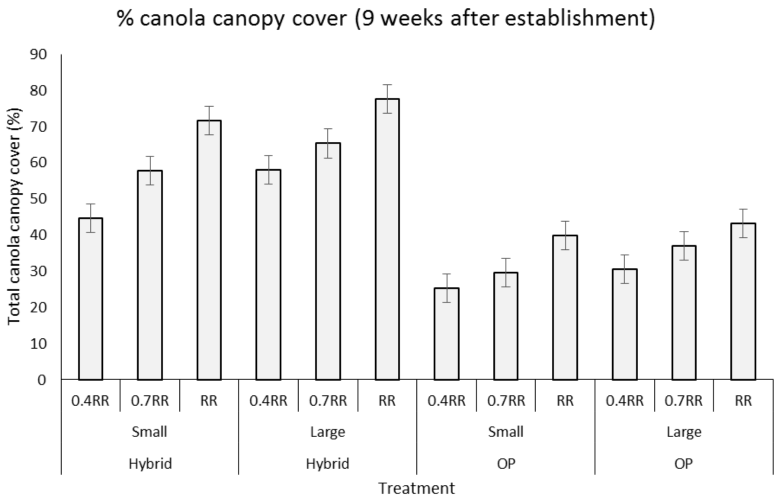

Figure 7 Percentage crop canopy cover 9 weeks after sowing at the Kojonup site in 2019.

CANOLA YIELD

Canola yield in this study was assessed both infested with ARG (using crop competition factors only) and in the herbicide applied weed free situation. When herbicides were applied, yields were consistently higher (P<0.001), with an interaction between pollination type and seed size identified (P=0.017), with larger increases in canola yield identified in open pollinated variety treatments when larger seed size (>2.0mm) was used. Canola yield in the absence of ARG was significantly increased in hybrid variety (Trophy) treatments (P<0.001) and at higher seeding rates (50 plants/m^2) (P=0.007) and when larger canola seed was used (P=0.02). When herbicides were not applied (with ARG), yields were reduced (P<0.001) with no interactions between the trial treatments identified (P>0.05). In high ARG densities, canola yield was significantly increased in the hybrid variety (Trophy) treatments (P<0.001) and at higher seeding rates (50 plants/m^2) (P=0.021). Canola seed size did not significantly increase canola yield in the herbicide free treatments (P>0.05) (Figure 8).

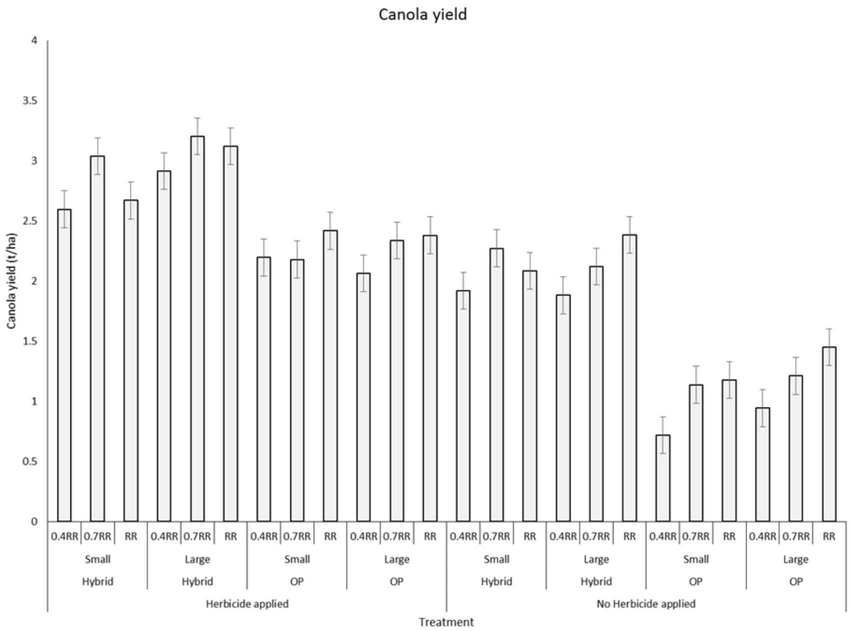

Figure 8 Total canola yield at the Kojonup site in 2019.

MILING 2019

ARG EMERGENCE

At the Miling site in 2019, no interactions or single factor significant differences were identified (P>0.05), however the data indicates that increasing canola seeding rate from 20 plants/m^2 to 50 plants/m^2 decreased ARG establishment (P=0.036) (Figure 9).

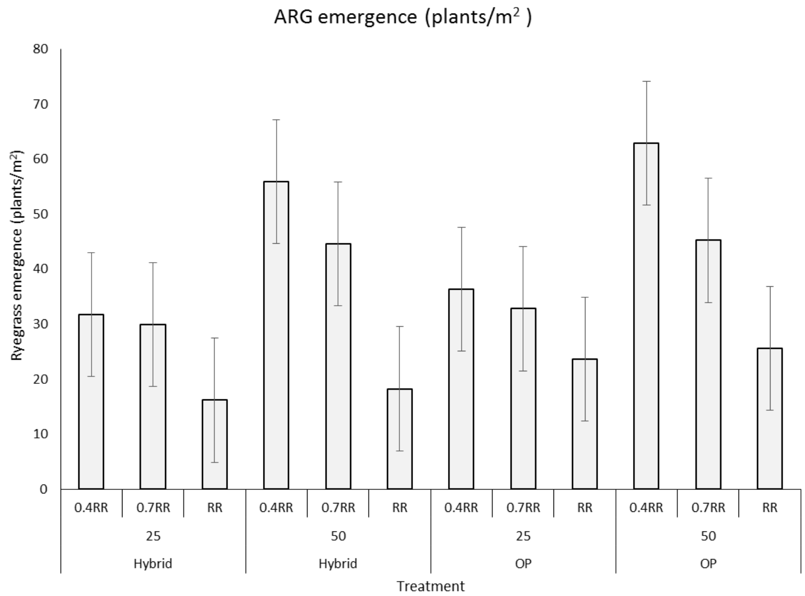

Figure 9 Annual ryegrass emergence at the Miling site in 2019.

ARG SEED PRODUCTION

At the Miling site in 2019, no interactions or single factor significant differences were identified (P>0.05). Whilst not statistically significant due to the variability at the Miling site in 2019, trends in the data indicate that increasing canola seeding rate from 20 plants/m^2 to 50 plants/m^2 reduced ARG seed production (Figure 10).

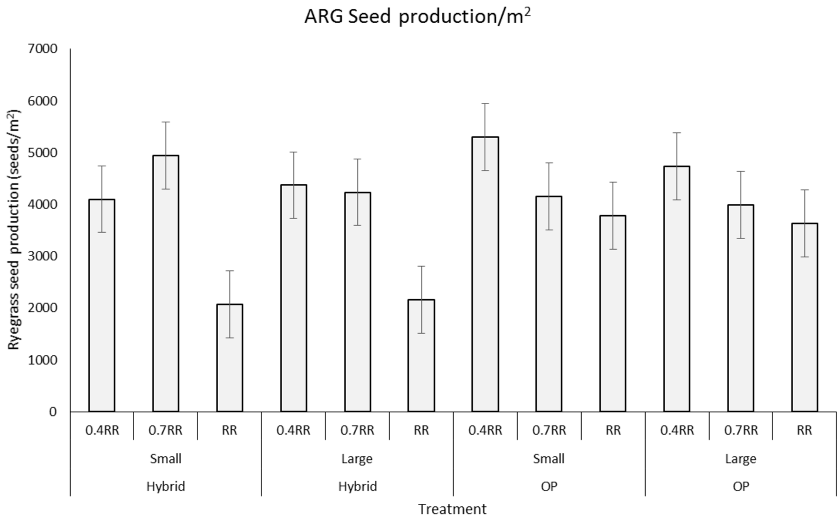

Figure 10 Annual ryegrass seed production at the Miling site in 2019.

CANOPY COVER

The early competitive ability of the canola treatments was demonstrated in the canopy cover (%) measured at 9WAE. At the Miling site in 2019, no interactions or single factor significant differences were identified (P>0.05). This uniformity on canopy cover despite the treatments applied has been attributed to the dry conditions at the Miling site in 2019 (Figure 11).

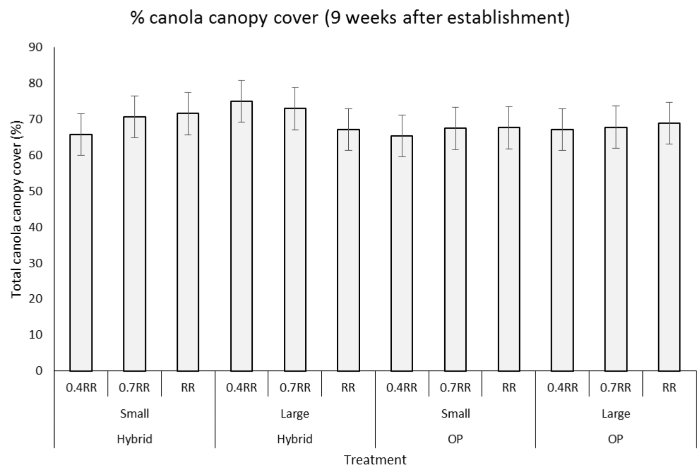

Figure 11 Percentage crop canopy cover 10 weeks after sowing at the Miling site in 2019.

CANOLA YIELD

Canola yield in this study was assessed in both the infested with ARG (using crop competition factors only) and in the herbicide applied weed free treatments. When herbicides were applied, yields were consistently higher (P<0.001). Within the herbicide applied (No ARG) treatment no interactions or single factor significant differences could be identified (P>0.05). However, canola yield with ARG competition was increased in the hybrid variety (Trophy) treatments (P<0.001) and when seed rate was increased from 20 to 50 plants/m^2 (P=0.021) (Figure 12).

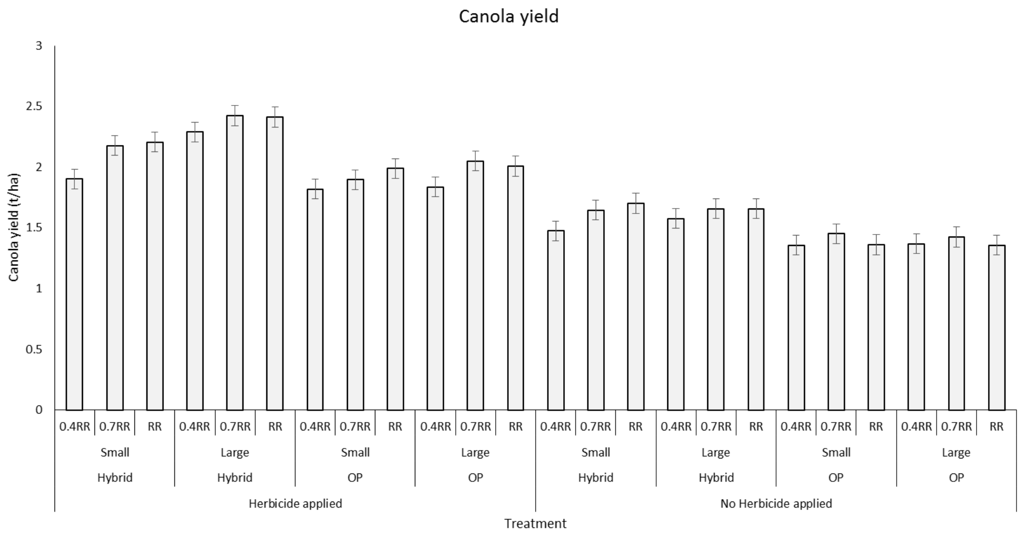

Figure 12 Total canola yield at the Miling site in 2019.

ACKNOWLEDGEMENTS

This research was funded by the Grains Research Development Corporation of Australia (GRDC).

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