

GOA trial site report

Canola - demonstrating crop and yield impacts by using second generation hybrid seed

Grain Orana Alliance

Trial code:	GAMA01524-2
Season/year:	Winter 2024
Farm name and location:	"Coradgery" Goonumbla
Grower/co-operator	Nathan Border
Agronomist /trial partner	Grain Orana Alliance

Keywords

GAMA015, canola, hybrid, conventional, seed, varieties, F2, second generation, Goonumbla, Parkes

Take home messages

- Sowing crops using second generation hybrid seed (F2) can reduce yields by 20% or more
- Sowing F2 seed can result in lower establishment and in-crop vigor in numerous varieties
- Using F2 seed had no practical impact on oil content.

Background

Since the end of the drought in 2020, the supply of hybrid canola varieties has often been limited. This shortage has been driven by a combination of production challenges, particularly during very wet seasons, and a consistent year-on-year increase in seed demand. As a result, many growers have been unable to access hybrid seed for their intended plantings. In response, some growers have opted to retain grain harvested from previous hybrid crops for use as planting seed. While this retained seed is often cleaned and treated with standard seed dressings, it remains significantly cheaper than commercially purchased hybrid seed. For some growers, this cost saving alone may appear to justify its use.

Grain harvested from hybrid canola is commonly referred to as F2 seed, or second-generation seed. Unlike the original hybrid (F1), this seed does not retain the homozygous genetic uniformity of the parent crop. Instead, it begins to segregate toward the original parental lines used to create the hybrid or forms unintended recombinations of those lines. This genetic drift leads to a loss or reduction of hybrid vigor; one of the key advantages of hybrid varieties. As a result, the performance of F2 seed is inherently more variable and often inferior, contributing to reduced yield potential and increased agronomic risk.

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During the GRDC NGN meetings held in 2024, the supply and cost of canola seed emerged as a key topic of concern across nearly all events. One area of particular interest was the potential yield penalty associated with sowing second-generation (F2) hybrid seed. While previous research suggests that yield losses from F2 seed can range between 10% and 45% ¹, many growers expressed scepticism about these figures, noting that much of the research has been conducted by suppliers of F1 hybrid seed. Subsequently, there is a considerable area sown with F2 seed in the Orana Region every year. Growers were interested in better understanding the yield and grain quality penalties (if any) of F2 crops.

Aims

- Assess the performance of farmer kept F2 hybrid canola seed against conventional F1 hybrid seed.

Treatment descriptions

- The trial design was a small plot randomized complete block design with 4 replicates.
- Five canola varieties common to the Orana Region were tested (Table 1).
- F2 seed was sourced from various growers.
- Both F1 and F2 seed were graded to a uniform size of 1.8 - 2.2 mm and sown with an assumed establishment of 60% targeting 30 plants/m².
- The F2 seed was treated with the same seed dressing as their F1 counterpart within each variety to account for any seed dressing effects

¹ Hybrid F1 canola vs F2 retained seed guide <https://www.pacificseeds.com.au/wp-content/uploads/2021/09/2021-Pacific-Seeds-Hyola-F1-Hybrid-vs-Retained-F2-Seed-Technote-FINAL.pdf>

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Table 1: Treatment list entailing canola varieties, generation and seed source.

Variety	Generation	Source
43Y92CL	F1	Pioneer
43Y92CL	F2	GOA
45Y93CL	F1	Pioneer
45Y93CL	F2	GOA
Diamond	F1	Nuseed
Diamond	F2	Nuseed
HyTTec Trophy	F1	Pioneer
HyTTec Trophy	F2	GOA
HyTTec Velocity	F1	Pioneer
HyTTec Velocity	F2	GOA

Rainfall: 2024 was an above average season in Parkes (Table 2), and the in-crop rainfall was approximately 243.6mm.

Table 2: Monthly rainfall² (mm) and long-term average (LTA) at trial site.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2024	106	41	20	63	70	72	44	58	16	44	75	85	694
LTA	53	50	46	41	42	45	41	42	36	46	53	48	543

Results

Results were analysed by ANOVA and results compared by using a LSD method with a 95% confidence interval. Any references to differences between treatments should be assumed to be statistically different unless otherwise stated. The full list of results is provided in the Appendix.

² Gridded data for the trial site from: Access Gridded Data | LongPaddock | Queensland Government

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Plant establishment and growth

- Growing F2 seed resulted in a lower plant establishment than F1 seed.
- For 43Y92CL there was no difference between generations for the remaining varieties tested (Figure 1).
- Growing F2 seed resulted in a lower NDVI (indicator of in-crop vigor) at 79 days after sowing (DAS) than the F1 for all varieties tested, except for HyTTec® Trophy and HyTTec® Velocity, for which there was no difference between generations (Figure 1).

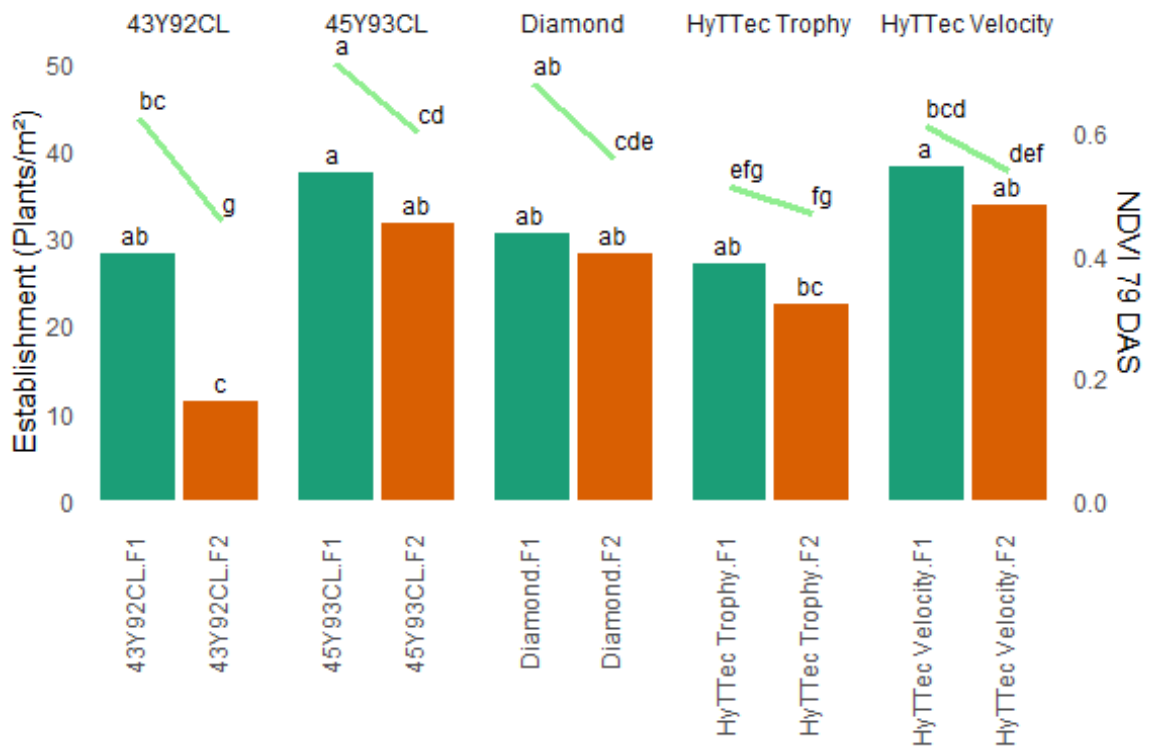


Figure 1: Plant establishment (bars) and NDVI (lines) by variety and generation. Treatments with the same letter are not significantly different, and significance between treatments may only be inferred within either plant establishment or NDVI measurements.

Yield

- The F2 seed was lower yielding than the F1 seed for all varieties (Figure 2).
- The highest yielding variety was F1 45Y93CL at 1.80t/ha.
- The lowest yielding was the F2 43Y92CL at 1.26t/ha (Figure 2).

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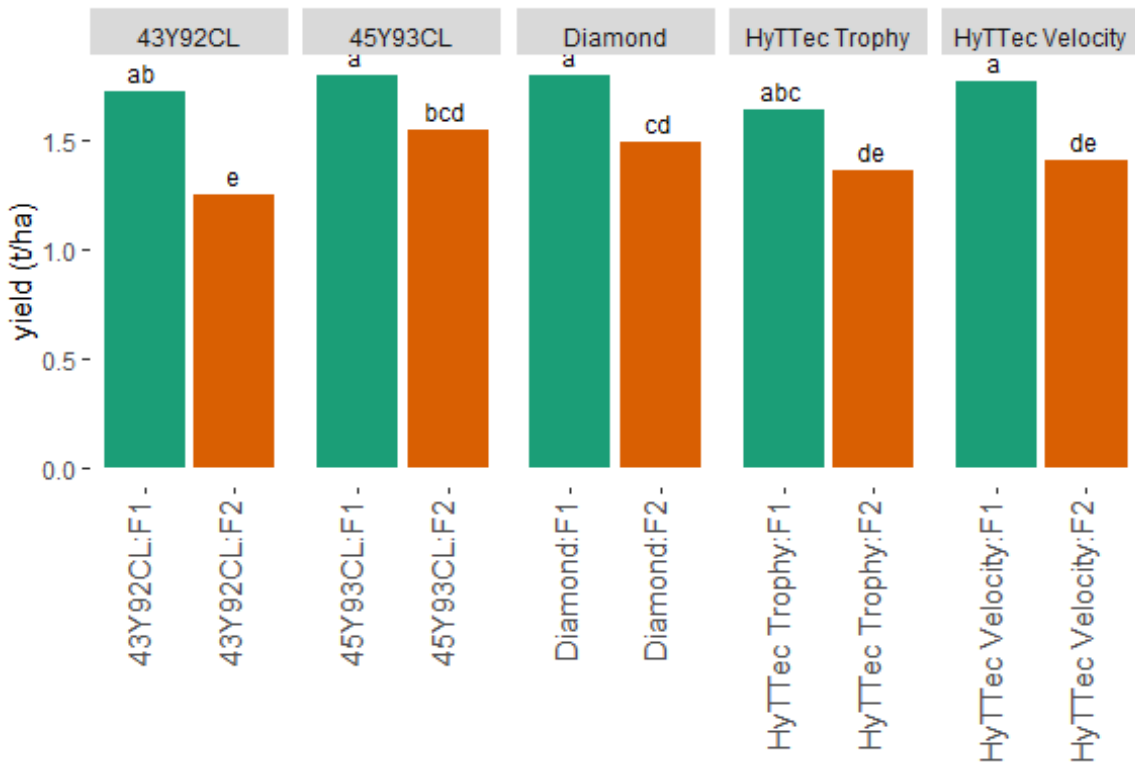


Figure 2: Plant establishment (bars) and NDVI (lines) by variety and generation. Treatments within the same measurement (establishment or NDVI) with the same letter are not significantly different.

Oil

- There was no practical difference in oil content for all varieties and treatments tested.
- The mean site oil was 43%.

Discussion

Consistent with findings reported by canola seed providers, this trial confirmed that sowing F2 hybrid seed results in a significant yield reduction compared to the F1 generation, regardless of establishment or in-crop vigor, as indicated by NDVI.

The highest yield loss was in 43Y92CL, with a reduction of approximately 0.47 t/ha (27%). The smallest yield loss was in HyTTec® Trophy, at around 0.28 t/ha (17%). (Table 3).

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Table 3: The relative yield difference between F1 and F2 generations of each variety tested.

Variety	F1 yield (t/ha)	F2 yield (t/ha)	Yield difference (t/ha)	Yield difference (%)
43Y92CL	1.73	1.26	0.47	27%
45Y93CL	1.80	1.55	0.25	14%
Diamond	1.80	1.49	0.31	17%
HyTTec Trophy	1.64	1.37	0.28	17%
HyTTec Velocity	1.78	1.41	0.37	21%

A common theory supporting the use of F2 canola seed is that, due to its lower cost and greater availability, it can be sown at higher rates to offset potential reductions in plant establishment and in-crop vigor, thereby maintaining yield. This trial observed reduced establishment in one variety and reduced vigor in most F2 varieties tested, lending some support to this idea. However, the trial also found that yield was significantly lower in the F2 generation, even in varieties where establishment and vigor were comparable to their F1 counterparts. This suggests that factors beyond establishment and vigor are contributing to the reduced yield performance of F2 seed. The likely explanation is genetic. The F2 generation contains a higher proportion of heterozygous and homozygous recessive phenotypes, which can express lower-yielding traits. As a result, growing F2 seed presents a substantial agronomic and economic risk, regardless of sowing rate.

Assuming hybrid canola seed costs approximately \$22/kg and is sown at a rate of 4 kg/ha, the cost of sowing F1 seed is around \$90/ha. With canola priced at approximately \$600/t, and a conservative estimate of a 20% yield reduction when using F2 seed, the economic impact becomes significant. At the trial site, which yielded an average of 1.6 t/ha, growing F2 seed would result in a raw economic loss of approximately \$192/ha. Even after accounting for the \$90/ha saved by not purchasing F1 seed, the net loss remains around \$102/ha. This implies that, despite the upfront savings on seed costs, growers incur both yield penalties and economic losses when sowing F2 seed, and sowing F1 seed is more economically viable.

Conclusions

Results from this trial indicate that sowing F2 hybrid canola seed can result in yield reductions of approximately 20% or more compared to the F1 generation, regardless of plant establishment or in-crop vigor. While avoiding the purchase of F1 hybrid seed may offer initial cost savings, the overall economic impact of using F2 seed remains significantly negative. When faced with the decision to sow either F1 hybrid seed or retained F2 seed, the findings from this trial suggest that growers are likely to be in a stronger economic position by investing in F1 seed. Alternatively, if hybrid seed supply is limited, selecting a non-hybrid (open-pollinated) variety may be a more reliable and cost-effective option than using F2 seed.

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Acknowledgements

The research undertaken as part of this project is made possible by the significant contributions of growers through both trial cooperation and the support of the GRDC. The authors would like to thank them for their continued support. Special thanks go out to Nathan Border who hosted this trial.

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Appendix

Variety	Generation	Source	Establishment		NDVI 79 DAS		Yield		Oil	
			(Plants/m ²)				(t/ha)		(%)	
43Y92CL	F1	Pioneer	28.25	ab	0.62	bc	1.73	ab	43.22	a
	F2	GOA	11.25	c	0.46	g	1.26	e	43.35	a
45Y93CL	F1	Pioneer	37.50	a	0.71	a	1.80	a	43.38	a
	F2	GOA	31.75	ab	0.60	cd	1.55	bcd	43.43	a
Diamond	F1	Nuseed	30.50	ab	0.68	ab	1.80	a	43.15	a
	F2	Nuseed	28.25	ab	0.56	cde	1.49	cd	42.40	b
HyTTec Trophy	F1	Pioneer	27.04	ab	0.51	efg	1.64	abc	43.23	a
	F2	GOA	22.50	bc	0.47	fg	1.37	de	43.33	a
HyTTec Velocity	F1	Pioneer	38.25	a	0.61	bcd	1.78	a	43.32	a
	F2	GOA	33.75	ab	0.54	def	1.41	de	43.18	a

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