RETAINING CANOLA SEED: A SAVING OR A HIGH RISK COST?

Simon Craig and Ciara Cullen (BCG)

TAKE HOME MESSAGES

- The hybrid canola 44Y84 (both certified and retained generations) yielded better than the open-pollinated variety 43C80, by an average of 0.3t/ha (20%).
- The hybrid established better than the OP variety. On average, 40% of seeds established as plants and plant densities above 20 plants/m^2 maximised grain yield.
- The use of certified seed for both open-pollinated and hybrid canola did not increase yields compared with retained seed for both hybrid and open-pollinated. However, view results with caution as the variability within the trial was high.

BACKGROUND

Hybrid canola has been one of the most adopted technologies of canola plant breeding since its transition from public to private occurred. A hybrid is a plant created by cross-pollinating male and female in-bred parents. The parent material is chosen to produce a hybrid (F1) with improvement in certain traits, such as increased yield, oil content, disease resistance and herbicide tolerance. Due to the significant investment required to breed hybrids, purchasing seed becomes a substantial up-front cost (approximately $22/kg). Because of this up-front investment, growers are reluctant to adopt or grow hybrid varieties. Recent seasons have favoured canola production; in those years, the yield advantages of hybrids have been observed.

There has been some grower interest in retaining hybrids from one season to the next, as they have traditionally done with open-pollinated (OP) varieties. Retaining hybrids to the second generation (F2) will produce seed that is inconsistent. Depending on how different the parent material is in certain traits, the F2 generation may vary greatly from the original. Such differences may occur in herbicide tolerance, blackleg resistance and maturity (GRDC 'Growing hybrid canola' fact sheet). Those differences may greatly affect the overall yield and financial returns to growers to the point that the initial savings from retaining the seed are outweighed.

AIM

To compare the performance of certified (F1) vs retained (F2) generations of an open-pollinated and hybrid canola variety at different plant densities.

METHOD

Location:	Sea Lake	
Replicates:	4	
Sowing date:	17 April	
Target plant density:	5, 10, 20, 40 and 80 plants/m^2	
Crop type:	43C80 (OP) and 44Y84 (hybrid) canola	
Fertiliser:	17 April	MAP (50kg/ha) (10% N, 21.9% P)
	12 July	GranAm (90kg/ha) (24% S, 20% N)
Herbicide:	17 April	Triflur X® (2L/ha) – all plots
	2 Nov	Reglone® (1.5L/ha) – all plots
Fungicide:	17 April	flutriafol (400ml/ha) – on fertiliser
Insecticide:	17 April	chlorpyrifos (300ml/ha) – pre-sowing
		Talstar (40ml/ha) – post-sowing
Seeding equipment:	BCG Gason parallelogram (knife points, press wheels on 30cm row spacing).	

This trial compared two varieties (43C80 and 44Y84) from different generations (certified and retained) at five plant densities (5, 10, 20, 40 and 80 plants/m^2). The retained generation was kept from BCG variety trials run in the 2011 season. Prior to sowing, each variety and generation was screened using a 1.8mm sieve, reducing the number of very small seeds. Seed counts and germination percentage were then determined for each seed source, and seeding rates were adjusted accordingly.

Table 1. The varieties and seeding rates used in this trial.

Variety	Generation	Target plant density (plants/m^2)
43C80 (OP)	Certified	5, 10, 20, 40 and 80
44Y84 (hybrid)	Retained	5, 10, 20, 40 and 80

The trial was sown and analysed in a complete randomised block design. Partial damage by galahs resulted in minor yield effects in some plots. These plots were scored prior to harvest and the scores were used as a co-variate in the analysis. Subsequently, the yields of those plots affected were predicted. No in-crop herbicides were required during the season because the paddock was clean. The trial was desiccated 10 days prior to being direct headed on 12 November.

RESULTS AND INTERPRETATION

Establishment

Marginal conditions at sowing resulted in a significantly lower germination and establishment than was expected. Generally, only 50-60% of the plants sown successfully established. Plant establishment improved with higher seeding rates (Figure 1). Establishment counts measured at 2-4 leaf and after harvest were on average 60% less than the target plant densities. This is typical of dry conditions. Differences in growth stages occurred because some partial germination had occurred after sowing (about 5%). However, the majority of plants germinated in late May and early June. The colder weather then slowed the growth down and the differences in the plants between the two germination dates persisted throughout the season.

The hybrid 44Y84 established more plants per square metre than 43C80 (Table 2). On average, the certified seed also produced higher plant densities than the retained seed. The interaction between variety and generation did not significantly affect plant establishment.

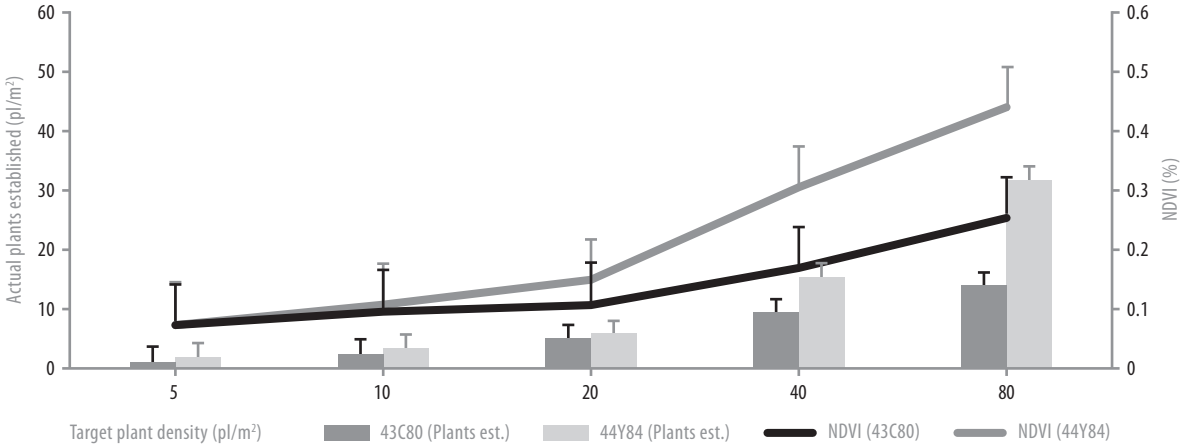

Figure 1. Effect of variety and target plant density (based on seeding rate) on plant establishment and plot NDVI values.

Note: a higher NVDI value suggests a bulkier or more vigorous crop. Plants were counted after harvest. NDVI: Variety: P<0.001, target plant density: P<0.001, Variety x target plant density: P=0.001, LSD=0.07, CV40%.

Table 2. Establishment of each treatment at the different plant densities.

Target plant density (plants/m²)	Plant establishment (plants/m²)				
	43C80 (OP)		44Y84 (Hybrid)		Mean plant est. (plants/m²)
	Certified	Retained	Certified	Retained	
5	2	1	2	2	**2**
10	3	3	4	3	**3**
20	7	4	7	4	**5**
40	9	10	16	15	**12**
80	13	14	30	34	**23**
Mean *(variety)*	**7**	**6**	**12**	**12**	
Sig. diff.					
Generation			NS (P=0.84)		
Variety			P<0.001		
Plant density			P<0.001		
Gen. x var.			NS (P=0.739)		
Gen. x plant d.			P=0.056		
Var. x plant d.			P<0.001		
Gen. x var. x plant d			NS (P=0.739)		
LSD (P=0.05)					
Generation			–		
Variety			1		
Plant density			2		
Gen. x var.			–		
Gen. x plant d.			3		
Var. x plant d.			3		
Gen. x var. x plant d			–		
CV%			28		

The better establishment of the hybrid (44Y84) was especially evident at the higher target plant densities, compared with the OP variety (43C80). This was consistent in both generations (F1 and F2) for each variety. Interestingly, the NDVI measurement taken at the 2-4 leaf stage showed a similar trend (Figure 1) which is possibly due to differences in establishment and plant vigour. Visual assessment taken during the season observed subtle differences between the 44Y84 and 43C80, but due to the variability in emergence times, this was not significant. It has been well documented in other studies that hybrids have greater vigour than OP.

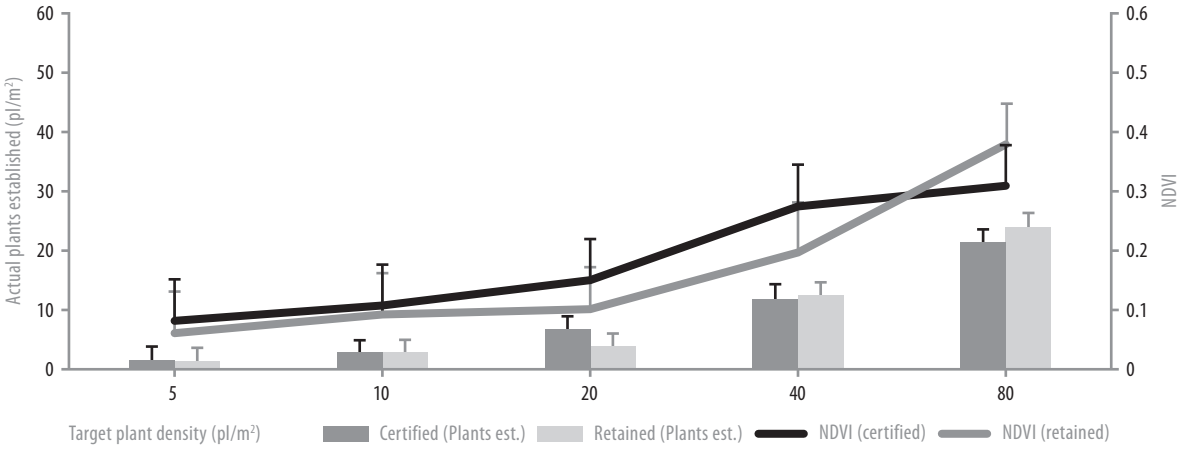

Figure 2. Effect of generation and target plant density (based on seeding rate) on plant establishment and plot NDVI values.

(NDVI; Generation NS (P=0.24), plant density: P<0.001, LSD=0.05, generation x plant density; P=0.004, LSD=2.5pl/m^2, CV40%)
Plant establishment statistical analysis is presented in Table 2.

While the establishment of canola from the certified seed was better than the retained seed on average across all treatments, there were no differences between the F1 and F2 for plant establishment and NDVI within a given target plant density (Figure 2).

A second NDVI measurement was taken at stem elongation (data not presented) and showed a significantly higher NDVI for the canola grown with certified seed (0.44) than the retained (0.34) generation (P=0.016, LSD=0.08, CV44%). The differences between the varieties and seeding rates were not significant.

Maturity

There was no effect on flowering time between the generations, although, as expected, and based on their relative maturing times, 43C80 did flower earlier than 44Y84. The hybrid was notably taller than 43C80, which was also expected.

Yield

In terms of grain yield, there was no measurable difference between retaining seed from either the OP variety or the hybrid (Table 3). The hybrid (44Y84) yielded higher than OP (43C80) variety at all plant densities.

Plant density significantly affected yield. The mean of all the varieties and generations increased with plant density up to 20 plants/m^2. Plant numbers were lower than expected, but this data reinforced that even at extremely low plant densities canola can compensate and yield surprisingly well.

It should be noted that the co-efficient of variation (CV) was reasonably high (19%). This means that there was some variation within the treatment's replicates. The implication of this is that small differences are less likely to be identified and subsequently a larger difference between the treatments is required to be certain of significant difference. Ideally, field trials should achieve a CV of less than 10% to have confidence in the data.

Table 3. Yield performances (t/ha) of the different generations of 43C80 (OP) and 44Y84 (hybrid) and mean plant density.

Target plant density (plants/m²)	Yield (t/ha)				
	43C80 (OP)		44Y84 (Hybrid)		Mean yield (t/ha)density)
	Certified	Retained	Certified	Retained	
5	1.04	1.12	1.35	1.28	1.20[a]
10	1.49	1.23	1.90	1.42	1.51[b]
20	1.66	1.63	2.09	1.96	1.84[c]
40	1.77	1.73	2.01	1.97	1.87[c]
80	1.81	1.99	2.13	2.00	1.98[c]
Mean *(Variety)*	1.5[a]		1.8[b]		-
Sig. diff.					
Variety			P<0.001		
Generation			NS		
Plant density			P<0.001		
Gen. x var.			NS		
Gen. x plant d.			NS		
Var. x plant d.			NS		
Gen. x var. x plant d			NS		
LSD (P=0.05)					
Variety			0.15t/ha		
Generation			–		
Plant density			0.23t/ha		
Gen. x var.			–		
Gen. x plant d.			–		
Var. x plant d.			–		
Gen. x var. x plant d.			–		
CV%			19		

Note: Treatments that are significantly different (P<0.05) are denoted by letters. Those treatments denoted with a different letter are significantly greater than or less than other treatments with different letters.

The hybrid (44Y84) yielded 0.3t/ha higher than the OP variety (43C80). Based on the December 3 prices of $520/t (consistent with this publication), this equates to $156/ha income above that of 43C80. Even when sown at 2kg/ha, this constitutes greater than a 3:1 return on investment above growing the OP variety.

Grain quality

In terms of grain quality, oil increased with seeding rate (P<0.001, LSD=1%, CV3.5%). A long, cool and moist growing season increases yield potential and the duration of oil deposition. Canola oil content and yield are dependent upon variety, conditions and water supply Given that yield increased incrementally with seeding rate, it is not surprising that oil would also be similar. The oil at the lower plant densities was 38%, while at the higher densities it was 40%. This contrasts with other research where oil content is generally unaffected by plant density. Usually a higher sowing rate has no effect on oil content: if anything, it would cause oil to decrease due to competition for moisture, especially in drier seasons. The reason plant density can increase yield is that very low plant numbers limit the potential to capture maximum moisture, sunlight and nutrients. The relationship then between oil and yield is not correlated, as was found in this trial. This could most likely be attributed to the softer season finish.

Test weight was acceptable for both varieties, but was higher in 43C80 (68kg/hL) than 44Y84 (64kg/hL) (P=0.007, LSD=3kg/hl, CV10.8%).

COMMERCIAL PRACTICE

For most farmers, growing canola involves higher input costs and correspondingly greater financial risk of crop failure in drier years. This season has demonstrated that canola can be profitable in drier years, only if there is stored soil moisture and prices are favourable. Price volatility is a risk in itself though, canola price has been favourable to growers in recent years due to a world shortage of grain ($320/t in April 2005, almost half that of 2012).

This trial showed the importance of ensuring plant densities in the Mallee are greater than 20 plants/m^2. When calculating sowing rates, common establishment rates of 40 to 60% should be taken into account. In very dry conditions, even lower establishment can occur. The hybrid in this trial established better than the OP variety, which was to be expected. However, hybrids generally have larger seeds and fewer seeds per bag so seed size needs to be factored in when calculating sowing rates.

Whilst this trial showed no significant effect on yield and quality between retained and certified seed, a number of other trials and publications show yield losses and negative economic returns associated with retaining hybrids. Retaining hybrids involves too many increased risks to be attractive. A retained hybrid may lose some of the traits for which breeders have selected such as height, maturity, yield, blackleg resistance and herbicide tolerance. The second (F2) generation will show up with some traits from each of the original parents. The amount of variability in the F2 will depend on the extent of the difference between the original two parent lines. As well, one in four F2 plants will also be 'male sterile'. If ideal conditions for insects during flowering (for cross-pollination) do not eventuate, yields will be further reduced. Canola is a high risk crop, it is more sensible and desirable to reduce costs elsewhere than to retain hybrid seed and increase that risk.

BCG will further investigate this in 2013 in order to compare a range of seasons.

REFERENCES

GRDC canola fact sheet 'Growing hybrid canola', August 2010. Accessed at www.grdc.com.au, 4 January, 2013.

ACKNOWLEDGMENTS

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