RETAINING HYBRID CANOLA

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TAKE HOME MESSAGES

- Retaining hybrid canola from one season to the next incurred a yield penalty of 0.3t/ha at Quambatook. There was a general penalty of 0.2t/ha for retained seed in the mean yield of all varieties (including OPs) at Horsham.
- Oil content and test weights of retained seed were lower at Quambatook, but not at Horsham.
- Retaining hybrid seed compromises plant vigour, disease resistance and herbicide tolerance. The yield advantages (0.2-0.3t/ha) from hybrid varieties, particularly within the Clearfield hybrid varieties, significantly outweigh the initial seed cost of $44/ha at 2kg/ha sowing rate.

KEY WORDS

Agronomy, canola, cost of production, F1, F2, hybrids, management, open-pollinated, retained canola seed, retained seed, varieties.

BACKGROUND

Canola has become a regular feature of Wimmera and Mallee crop rotations as growers have become more confident about its management. The biggest change has occurred in the Mallee, with around 15-20 per cent (%) of paddocks now sown to canola annually. Previously considered as a high risk crop, better varieties and management practices have somewhat reduced the – perceived – risk of growing canola and provided growers with a valuable weed and disease break for future years.

One of the significant changes in canola breeding has been the development of hybrid varieties that can out-yield open-pollinated (OP) varieties. One of the greatest barriers to adoption of hybrid varieties is the initial seed cost. Although the per kilogram cost of hybrid canola ($22/kg) is double that of OP varieties ($9-11/kg), the real cost is not having the ability to bulk up seed from one season to the next. Typically, growers will sow only a small area (1-10ha) of a certified 'purchased' OP seed, with the intention to use that seed to sow all of their canola the following season. This reduces the seed cost from $44/ha to $1/ha at 2kg/ha. Potential establishment issues such as dry sowing, mice, locusts and false breaks can expose the business to increased risk if the crop fails to establish. As canola breeding moves towards hybrid technology, there will be limited OP options available to growers. For the Mallee, or areas where canola has higher risk, ordering seed for up to 20% of the farm (500ha), would cost up to $22,000 (hybrid) compared to $500 (OP).

Inevitably, growers have asked what the penalty for retaining hybrid seed from one season to the next might be. The reason this practice is not recommended is that the second generation (F2) of the hybrid canola may inherit the traits of only one of its parents. If a hybrid is made up of parent material that has good vigour and blackleg resistance, but poor yielding, and the other parent is a high yielder without the other traits, the F1 hybrid can be a high yielding, vigorous variety with blackleg resistance. If that hybrid is retained, the F2 seed may revert to maintain only the traits of one of its parents (e.g. good vigour and blackleg resistance, but poor yielding). Without knowing the original parent material of each variety, it is difficult to determine the expected yield loss for specific varieties.

AIM

To determine the yield penalty for retaining hybrid canola varieties in different yielding and disease environments (Mallee and Wimmera).

METHOD

Two replicated field trials were sown using a complete randomised block trial design. First (F1) and second generation (F2) seed from 12 different canola varieties were used in this trial. Three varieties of each canola type (Triazine Tolerant, Clearfield, Roundup Ready and Conventional) were chosen. Of those varieties, one was a commonly grown OP variety in the region while the other two were hybrids. The varieties were also selected based on a similar maturity to allow for a better comparison, eliminating the risk of seasonal effects such as frost or heat stress. There is no OP variety within the Roundup Ready group so another hybrid was used instead.

Each variety was graded and cleaned to ensure that seeds of similar size were compared. Germination percentages were also determined for each variety. Seeding rates were adjusted to achieve a target plant density of 40 plants/m^2 based on a germination percentage and 1000 seed count.

The Quambatook trial was sown dry into cereal stubble that had been chemical fallow in 2012, while Horsham was also dry sown into a wheat paddock.

Locations:	Quambatook (Mallee) and Horsham (Wimmera)
Replicates:	Four
Sowing dates:	14 May (Quambatook)
	9 May (Horsham)
Target plant density:	40 plants/m^2
Seeding equipment:	BCG Gason parallelogram cone seeder (knife point, press wheels, 30cm row spacings)

The specific trial details, variety information (pp. 92) and list of applications (pp. 96) are listed in the 'Canola varieties' article.

Normalised Difference Vegetative Index (NDVI) is a measure of the crop reflectance, which is strongly influenced by the chlorophyll content 'greenness' and biomass of the crop. The greater the chlorophyll content and biomass of the crop, the larger the NDVI value which ranges between 0 (bare ground) and 1 (canopy saturation). NDVI (measured by a handheld Greenseeker®) was taken at the Quambatook site at late cabbage to early bud formation, but not taken at Horsham due to site accessibility at the time.

Table 1. List of varieties within each herbicide group sown at Quambatook and Horsham.

Canola type	Variety	
	Quambatook	Horsham
Triazine tolerant (TT)	Crusher (OP)	Crusher (OP)
	Hyola® 555TT (Hybrid)	Hyola® 555TT (Hybrid)
	Hyola® 559TT (Hybrid)	Hyola® 559TT (Hybrid)
Clearfield (Clf)	43C80 (OP)	43C80 (OP)
	44Y84 (Hybrid)	44Y84 (Hybrid)
	43Y85 (Hybrid)	45Y82 (Hybrid)
Roundup Ready (RR)	43Y23 (Hybrid)	43Y23 (Hybrid)
	Hyola® 505 (Hybrid)	Hyola® 505 (Hybrid)
	IH50 (Hybrid)	IH50 (Hybrid)
Conventional (conv)	AV Garnet (OP)	AV Garnet (OP)
	Hyola® 433 (Hybrid)	Hyola® 433 (Hybrid)
	Hyola® 50 (Hybrid)	Hyola® 50 (Hybrid)

Plots were direct-headed with a Kingaroy plot harvester and oil content was measured using a Foss Infratec NIR whole grain analyser. Yields were corrected to 6% moisture. To ensure all varieties matured together, all plots were desiccated prior to harvest. Any shattering or brackling within plots was accounted for in this analysis.

RESULTS AND INTERPRETATION

Throughout the season, visual differences were evident in establishment, vigour and flowering date at both sites, but the yield results were indifferent. The performance of varieties varied between Horsham and Quambatook, with hybrid varieties out-yielding OP varieties at Quambatook, while OP varieties performed a lot better at Horsham.

Quambatook

The NDVI values taken at Quambatook during late cabbage to early bud formation (Figure 1 and Table 2) illustrate the effect of retaining hybrid seed, with a significant reduction in 'canopy greenness' (mean of hybrid compared to mean of OP varieties). Interestingly, there was no significant differences in the mean NDVI between either of the OP generations and the retained hybrids (F2). This would suggest that in-field commercial comparisons between retained hybrids and either generation of the OP varieties may not truly show the effect of retaining that hybrid unless there was a F1 of certified hybrid to which to compare it.

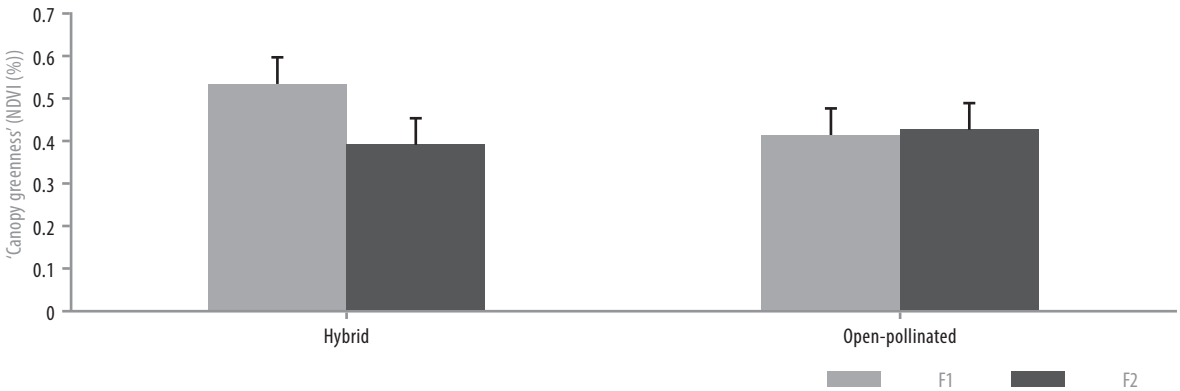

Figure 1. The mean 'canopy greenness' values (measured as NDVI) at late cabbage to early bud formation at Quambatook.

Table 2. Crop production data from the Quambatook site. Shaded values indicate that the treatment is significantly lower than the F1 generation.

Variety	'Canopy greenness' NDVI (%)		Grain yield (t/ha)		Oil (%)	
	F1	F2	F1	F2	F1	F2
43C80	0.40	0.42	1.04	1.15	38	37
43Y85	0.53	0.43	1.26	0.99	38	37
44Y84	0.49	0.42	1.46	1.17	39	37
Crusher TT	0.28	0.34	1.32	1.23	34	36
Hyola® 555TT	0.53	0.27	1.42	0.79	37	36
Hyola® 559TT	0.41	0.38	1.21	1.02	40	39
Garnet	0.57	0.53	1.52	1.53	39	38
Hyola® 433	0.51	0.41	1.62	1.25	41	39
Hyola® 50	0.65	0.51	1.63	1.39	40	39
43Y23	0.54	0.28	1.85	1.12	37	34
Hyola® 505	0.66	0.48	1.71	1.44	39	40
IH50	0.52	0.34	1.48	1.07	36	34
Mean	0.51	0.40	1.46	1.18	38	37
Sig. diff.						
Variety	P<0.001		P<0.001		P<0.001	
Generation	P<0.001		P<0.001		P<0.001	
Variety x generation	P<0.001		P=0.012		NS	
LSD						
Variety	0.06		0.22		1	
Generation	0.02		0.09		1	
Variety x generation	0.09		0.31		–	
CV%	13.3		16.5		3.9	

A similar trend was seen in grain yield (Figure 2), with the hybrid F1 yielding more than the hybrid F2 and both OP lines. This would suggest that the early vigour and 'canopy greenness' is a key to the yield advantage of hybrids over OP varieties. While there was a significant reduction in yield when the hybrid varieties were retained, there was no yield loss found in the OP, as would be expected.

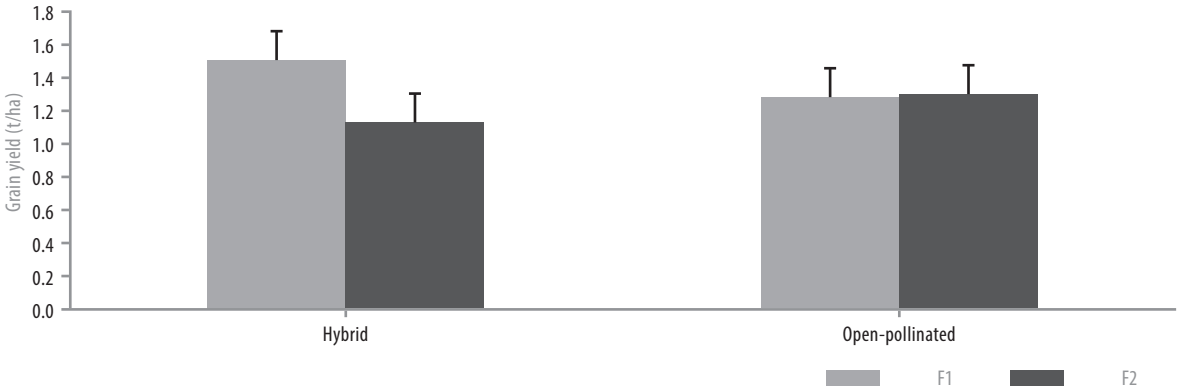

Figure 2. Mean grain yield of hybrid varieties versus OP varieties at Quambatook.

The RR and conventional varieties performed exceptionally well, while the TT and CL lines were at the lower end (Table 2). A hybrid variety was the highest yielding within each herbicide group by at least 0.1t/ha, provided it was of F1 generation only, most notably in Pioneer 44Y84 (1.46t/ha) compared with

43C80 (1.04t/ha) in the CLs. There was a not a significant difference between OP and hybrids within the TT and conventional groups

In terms of yield loss, from F1 to F2 generations, specific varieties lost more yield than others: 43Y23 (-0.73t/ha), Hyola® 555TT (-0.63t/ha), IH50 (-0.41t/ha) and Hyola® 433 (-0.37t/ha) all had significantly lower yield in the F2 compared to the F1 generation.

Varietal differences were observed in all measurements (canopy greenness, grain yield, oil content and test weight) as did the different generations (Table 2). There was a mean yield difference of 0.28t/ha between F1 and F2 generations (mean of all varieties). Not all varieties were affected similarly, with a significant variety by generation interaction found in all measurements except oil content. OP varieties did not have any significant differences at any of the measurements. The mean of the F1 varieties had slightly higher oil and test weights than F2.

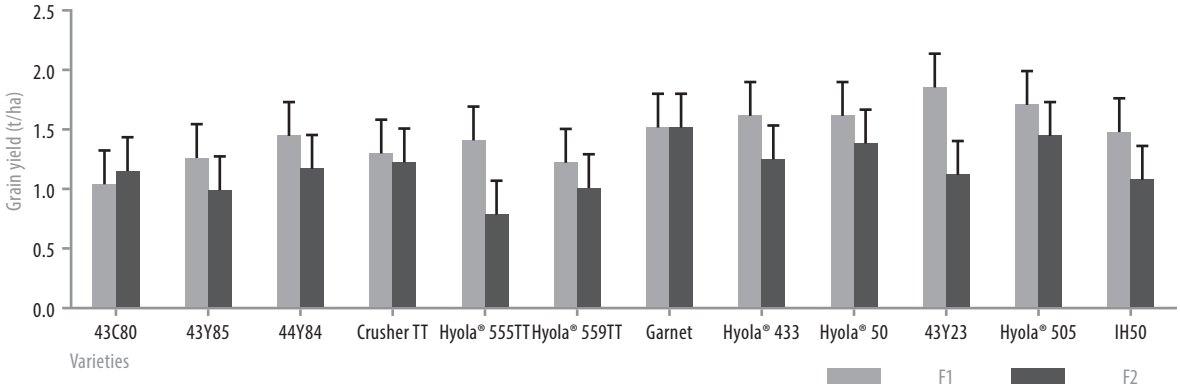

Figure 3. Grain yield of both 1st and 2nd generations (F1 and F2) for all the varieties at Quambatook.

Horsham

Similarly to Quambatook, there was a significant yield loss from retaining hybrid seed as OP seed (Figure 4). No difference in grain quality between the generations was observed, but some varieties produced lower oil content (P=0.02, LSD=1%, CV1.9%) and test weights when retained (variety x generation: P=0.05, LSD=1kg/hl, CV1.1%). Hyola 555TT was found to have significantly lower oil and test weight in the F2 generation than the F1.

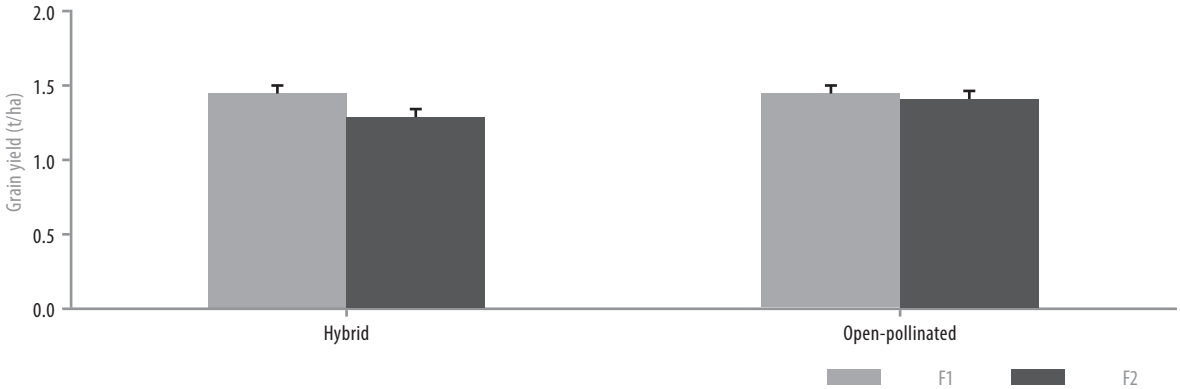

Figure 4. Grain yield of both 1st and 2nd generations (F1 and F2) for all the varieties at Horsham (P<0.001, LSD=0.07t/ha, CV6%).

In order to balance the trial design for comparison of varieties within each herbicide group, the yield of the best hybrid was analysed against the OP variety at the different generations (Figure 5). RR varieties were not included as there was no OP variety for comparison. The figure below shows that each hybrid had significantly lower yield when retained, while there was no difference in the OP varieties.

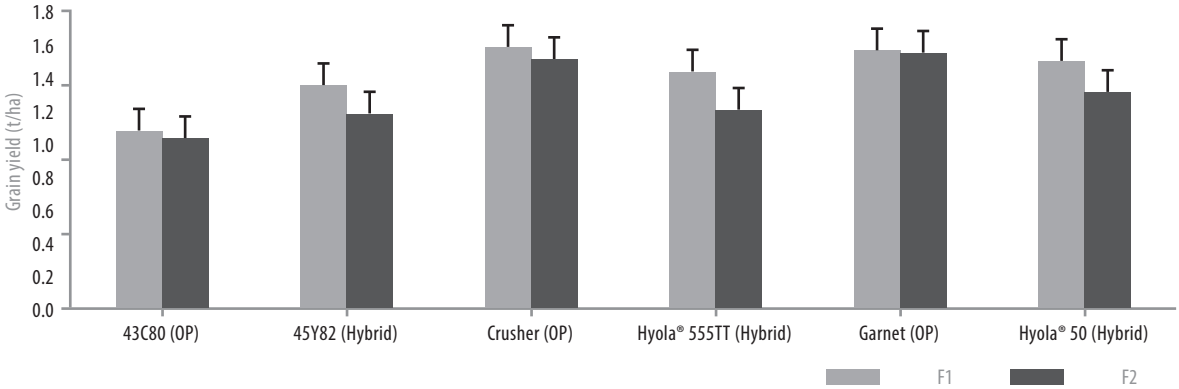

Figure 5. Grain yield for each variety (F1 and F2) at Horsham (P=0.049, LSD=0.13t/ha, CV5.5%).

In general, the yields of the canola across the site were lower than those achieved in the district (>2t/ha), though the site received exceptional rainfall during the season). Due to the continuous rain events during the late winter, accessibility was limited for the third application of urea which was subsequently missed. Possibly the crop was deficient in N; an additional application of nitrogen may have produced higher yields.

COMMERCIAL PRACTICE

In general, the most cases in which canola tends to fail are related to poor establishment and vigour, with the exception of climatic influences and nutrition. The attributes and benefits of retaining hybrids are strongly linked to early vigour, which leads to better establishment, particularly in tougher environments (e.g. Mallee). When a hybrid variety is retained from one year to the next, those benefits are being compromised and the logic behind doing so should be questioned.

While other studies have found similar results they have attributed the differences between hybrids to "the hybrid breeding system being used by the different companies and the degree of heterosis between parental lines that are used to produce each hybrid" (Trent Potter pers comm).

The mean yield loss that was found at both sites was 0.2t/ha for all hybrid varieties. Grain growers need to weigh up retaining seed versus purchasing certified seed. Assuming a 2kg/ha sowing rate and a seed cost of approximately $44/ha, there would need to be a benefit of more than 0.1t/ha (at $500/t) to justify purchasing certified seed. Conversely, retaining hybrid seed compromises plant vigour, disease resistance and herbicide tolerance. In addition, growers need to consider the additional costs of storage, cleaning and seed treatment when retaining the seed.

ACKNOWLEDGMENTS

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