

Manage risk when planning to grow hybrid TT varieties

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Key messages

- The yield threshold calculated for equal profit between hybrid and OP TT varieties was 1.2t/ha and the 1:2 rate of return yield threshold was 2.5t/ha.
- There is no gain to the grower where TT hybrids have equal profit to OP varieties. Check whether you are getting at least double your money back, to cover the higher risk of not recovering your seed cost.
- Hybrids were equally profitable at low (25 plants/m²) and high (50 plants/m²) plant densities in three 2018 trials. In high yielding situations, where the hybrid investment payoff is more likely, reduce production risk by using a reasonable seeding rate.
- If you are expecting more than 1.2t/ha, it's worth trialling TT hybrids. Sow strips of a suitable hybrid variety to compare your returns with ATR Bonito.
- Otherwise, we recommend using hybrid TT varieties when the 1:2 return is reasonably reliable then using seeding rates to target optimal crop densities of 25-50 plants/m².

Aim

To compare the relative profitability of open pollinated TT varieties with hybrid TT varieties. The yield threshold for changing to hybrid TT varieties is calculated at equal profit (1:1 return) and 1:2 rate of return, which is suggested to cover the additional financial and production risks of growing hybrid varieties.

Background

NVT results show an increasing yield gap between open pollinated TT varieties and newer hybrid TT varieties. This is not surprising since ATR Bonito (the most widely grown OP variety) was released in 2013 and there have been 22 hybrid TT varieties released since then. The yield difference is approximately 10-15% in NVT trials.

When farmers grow hybrid varieties they are exposed to higher financial risk, from higher up-front seed costs, and often higher production risk as well, since growers often use lower seeding rates in an effort to reduce costs. Changing to a hybrid TT variety at the threshold where hybrid profits equal OP profits is of no value to growers, as they have a higher risk profile but no overall increase in profit. . Most growers tell us they target a 1:2 or 1:3 return on seed cost investment.

NVT trials are sown at high seeding rates (undisclosed to the public) to target 40 plants/m² in the Early NVT series and 50 plants/m² in the Mid series. This is in keeping with DPIRD optimum density recommendations for hybrid canola varieties of 25-35 plants/m² in low rainfall areas, 25-40 plants/m² in medium rainfall areas and 40-60plants/m² in high rainfall areas (French et al, 2018). However, hybrids are commonly grown at lower densities on-farm, at around 25 plants/m², to save on seed costs. DPRID trials were set up to investigate the relative profitability between retained ATR Bonito (OP) seed and selected new hybrid varieties sown at high (50 plants/m²) and low density (25 plants/m²) (see Section 1 - DPIRD agronomy trials)

Current suggested thresholds for a 1:1 return (equal profit) and 1:2 returns from changing to hybrid TT varieties are 1.1t/ha and 1.9t/ha, respectively (Zhang et al, 2018). The economic model has been refined and updated here (see Section 2 - Yield threshold calculations).

In another method of comparison, we use the 2014-18 NVT MET data to calculate approximate profit from TT hybrids, over the most common OP variety, ATR Bonito, as well as calculating affordability of hybrid seed (kg/ha) at equal profit threshold (see Section 3 - Additional returns).

Methods

1. 2018 DPIRD agronomy trials

Three field trials were conducted by DPIRD, at Cunderdin, Merredin and Grass Patch in 2018. The open pollinated variety ATR Bonito (50 plants/m²) was compared with hybrid varieties at 25 and 50 plants/m². The ATR Bonito seed had been retained at harvest and was graded over a 2mm slotted sieve (4% was retained above the sieve).

There were several OP treatments; commercial seed and seed that had been retained over 1-4 harvests. The retained seed treatments had very similar results to each other.

For simplicity, the results from OP seed that had been retained after one harvest is reported here.

The seed size varied, from Pioneer 44T02 at 240,000 seeds/kg to Hyola 350TT at 130,000 seeds/kg (Table 1). The seeding rates for the 50 plants/m² plots were 3.3 and 6.6kg/ha, respectively. The ATR Bonito had a medium seed size but a similar seeding rate to the Hyola 350TT due to a lower germination % and lower expected field establishment (50% compared to 65% for hybrids).

Table 1. Seed size and seeding rates used in trials

Variety	Seeds/kg	Seed size (mg)	Seeding rate (kg/ha)	
			Density target 25 p/m ²	Density target 50 p/m ²
ATR Bonito (OP)	199,250	5	N/A	6.5
Hyola 350TT	129,000	7.8	3.3	6.6
InVigor T 4510	183,500	5.5	2.2	4.4
HyTTec Trophy	196,000	5.1	2.1	4.1
Pioneer 44T02 TT	241,000	4.2	1.7	3.3

2. Yield threshold for equal profit and 1:2 rate of return for hybrids, compared with ATR Bonito

We calculated the yield threshold where changing to a hybrid TT variety is of equal profit compared with growing ATR Bonito, and the threshold where yield increases gave a 1:2 return on seed cost investment. We followed the economic model developed by Zhang et al, (2018). The model was refined here to take into account the comparative seed value, so the return rate was calculated on the extra cost of hybrid seed, compared to the value of OP seed generally used at seeding. The analysis was also updated using NVT single site data for 2014-2018 and 2019 approximate seed prices. The average yield data from all commercial hybrid varieties was used as there is limited data available for newly released lines. The model was run at 4kg/ha seeding rate for hybrids and 4kg/ha for OP, whereas previous reporting was at 2.5kg/ha for hybrid seed. The gross margin analysis was conducted based on a farm gate grain price of \$550/t, \$5 end point royalty (EPR) for ATR Bonito, seed costs of \$3/kg for retained OP TT varieties and \$30/kg for hybrid TT seed, and variable costs for nitrogen fertiliser, based on the trial yields.

3. Additional returns of hybrid varieties relative to ATR Bonito

The additional gross return of hybrid varieties, compared with ATR Bonito, were calculated based on the 2014-18 NVT data (NVT data presented in the associated GRDC Research Update paper- New canola varieties and long term NVT yields of all canola varieties). The value of the predicted yields and oil bonus were calculated and compared with the returns from ATR Bonito. The approximate affordability (kg/ha) of hybrid seed that could be purchased using the additional returns was also calculated, according to the additional return generated by each variety and 2019 seed prices.

Results

1. 2018 DPIRD field trials

There was an excellent (100%) field establishment at the Cunderdin trial, so observed plant numbers were all higher than expected, an average of 76 plants/m² in the high density hybrid plots (Table 2). The average field establishment was 51% for Grass Patch and 41% for Merredin. There was a higher number of OP plants than hybrids, at the 50 plants/m² density target, as the field establishment was expected to be lower for OP seed (50%) compared with hybrid seed (65%), but the observed field establishment was very similar, likely due to the large OP seed size.

OP vs hybrid yields and gross margin

The Cunderdin average trial yield was 2.6t/ha and only the HyTTec Trophy treatment at 50 plants/m² had significantly higher yields than ATR Bonito. The ATR Bonito treatment had a significantly higher gross margin than the Hyola 350TT 25 plants/m² treatment, but was lower than the HyTTec Trophy 50 plants/m² treatment by \$107/ha. The average trial yield was 1.0t/ha at Grass Patch, where conditions were tight for an extended period after seeding. The yields of hybrids at all densities were significantly higher than for ATR Bonito, except for the Pioneer 44T02 treatment at 25 plants/m² (Table 3). The gross margin for the InVigor T4510 and HyTTec Trophy treatments at both 25 and 50 plants/m² were significantly higher than the open pollinated treatment, with an average of \$80/ha benefit. At Merredin where the average trial yield was 1.0t/ha, there were no significant differences in yield or gross margin between treatments.

These results were unexpected given recent recommendations of profit equalisation between OP and hybrid TT varieties at 1.1t/ha and 1:2 return on seed cost investment at 1.9t/ha. (Zhang et al, 2018). Despite the high trial yields (2.6t/ha) there was only a single hybrid treatment with higher gross margin at Cunderdin, but half the hybrid treatments had significantly higher profits than ATR Bonito at the lower yielding Grass Patch site. The Grass Patch results may be due to better hybrid performance under tough conditions, as is anecdotally reported in the north with RR varieties. The results illustrate both the opportunities available with hybrid TT varieties and the unpredictable financial gain involved with the up-front investment.

Hybrid high vs low seeding rates- yields and gross margins

Half the hybrid treatments sown at higher seeding rates had significantly higher yields at both Cunderdin (Hyola 350TT and HyTTec Trophy) and Grass Patch (InVigor T4510 and Pioneer 44T02) trials. This was surprising at the Cunderdin site since emergence was 100% and the low density target of 25 plant/m² had 42 plants/m² (Table 3). However, there were no significant differences in gross margin between the hybrid high and low seeding rate treatments at either site. This is important to note. When growing hybrids, low seeding rates are commonly used, with increased risk of poor emergence. In these trials, higher hybrid seeding rates gave similar economic returns with lower production risk, although higher financial risk.

These results also provide evidence that calculating returns according to NVT predicted yields but calculating costs by attributing lower seeding rates is likely to result in higher gross margins and lower yield thresholds than is correct. We have amended this in the next section by using the same 4kg/ha seeding rate to calculate the yield thresholds to change to hybrid TT varieties.

Table 2. Observed plant density (p/m²) and average field establishment (FE%).

Location	Observed plant density (target density)			Site average FE (%)
	OP 50p/m ² target	Hybrid 25 p/m ² target	Hybrid 50 p/m ² target	
Cunderdin	97	42	76	102
Grass Patch	51	21	36	51
Merredin	36	17	32	41

Table 3. Seed yield and gross margin of open pollinated and hybrid treatments.

Variety (target density)	Seed yield (t/ha)			Gross margin (\$/ha)		
	Cunderdin	Grass Patch	Merredin	Cunderdin	Grass Patch	Merredin
ATR Bonito Retained, graded 50p/m ²	1.56	0.87	1.08	596	232	252
Hyola 350TT 25p/m ²	1.43	1.09	1.06	448	285	290
Hyola 350TT 50p/m ²	1.74	1.20	1.09	543	276	192
InVigor T4510 25p/m ²	1.54	1.11	0.96	527	325	243
InVigor T4510 50p/m ²	1.62	1.24	1.14	519	352	186
HyTTec Trophy 25p/m ²	1.72	1.11	1.06	634	324	208
HyTTec Trophy 50 p/m ²	1.95	1.21	0.97	703	326	237
Pioneer 44T02 25p/m ²	1.56	0.88	1.14	568	214	227
Pioneer 44T02 50p/m ²	1.57	1.08	1.16	540	283	251
F-probability	<0.001	<0.001	NS	<0.001	<0.001	NS
LSD	0.19	0.12		106	74	

2. Yield threshold for equal profit and 1:2 rate of return for hybrids, compared with ATR Bonito

The yield threshold calculated for equal profit between hybrid and OP TT varieties was 1.2t/ha and the 1:2 rate of return yield threshold was 2.5t/ha. These thresholds were calculated using the approximate seed rate used in NVT (4kg/ha) and 2014-18 NVT results. The return rate was limited to the extra cost of hybrid compared with OP seeding costs. Results from the DPIRD trials indicate that using the higher seeding rate for both hybrid and OP seed in the model is a valid approach to finding the yield threshold to change variety types.

We expect the same yield thresholds to apply where growers use reduced seeding rates on farm. Reducing the seeding rate is likely to cause lower yields and lower costs, for a similar gross margin, as shown in the DPIRD trials at Cunderdin and Grass Patch. The relative gross margins between types determines the yield thresholds.

There is a large difference in the yield threshold to get a 1:2 return on seed cost investment, rather than equal profits, because of the small incremental gains between open pollinated and hybrid varieties. Where ATR Bonito yields 1.0t/ha, the predicted hybrid yield is 1.13t/ha and for a 2.0t/ha OP yield, the hybrid yield is 2.27t/ha, this is a 140kg/ha (or \$77/ha) gain to hybrids for each t/ha yield of open pollinated varieties.

3. Additional returns of hybrid varieties relative to ATR Bonito

In nearly all cases, the hybrid varieties generated greater gross returns compared with ATR Bonito. Hybrids generally had higher yields although a lower oil bonus. The additional gross returns (not profit) from hybrid varieties would be used to cover the higher cost of hybrid seed.

The likely return of ATR Bonito is \$425 where a 0.75t/ha yield is expected, and \$525 for InVigor T 3510, or \$100 worth of additional returns (Table 4). The shaded cells in Table 4 indicate that generating profits at or over the 1:1 rate of return (\$108/ha) is largely in the yield groups at or over 1.75t/ha and there are only a few examples where the gross returns cover a 1:2 rate of return (\$216/ha)

We calculated how much hybrid seed we could buy with the additional returns, to see whether it would cover the 40-50 plants/m² target plant population used to generate the returns (Table 5). The affordability (kg/ha) of hybrid seed varied according to the additional returns generated by each variety and seed cost. HyTTec Trophy was the most affordable variety overall, with returns in the Mid series environments able to cover the cost of 3.8 kg/ha seeding rate, at crop yields of 1.75t/ha and the 1:1 rate of return. For a 1:2 rate of return, the seeding rate should be no more than half of the seeding affordability shown in Table 5.

Table 4. Additional gross returns (\$/ha) from Hybrid TT varieties compared with ATR Bonito, calculated from NVT MET (2014-2018)

TT variety	Variety maturity	Early trial series				Mid trial series				
		0.75 t/ha	1.25 t/ha	1.75 t/ha	2.25 t/ha	1.25 t/ha	1.75 t/ha	2.25 t/ha	2.75 t/ha	3.25 t/ha
ATR Bonito return (\$/ha)		425	709	993	1276	716	983	1276	1560	1862
InVigor T 3510	3	100	89	94	121	81	124	134	148	-
Hyola 350TT		29	70	98	113	63	128	113	138	-
SF Spark TT		-	-	157	-	-	87	48	59	-
HyTTec Trophy	4	110	92	109	141	113	149	216	249	-
InVigor T 4510		96	117	134	160	96	154	211	242	323
Pioneer 44T02TT		82	94	122	144	87	102	105	129	152
SF Turbine TT		67	76	76	98	47	106	124	120	142
Hyola 550TT	5	46	-	-	-	-	107	151	184	-
SF Ignite TT		-	-	-	-	24	124	185	195	249
Hyola 559TT		112	114	140	167	107	99	127	172	222
Pioneer 45T03TT		-	-	-	-		87	87	74	-
DG 670TT	6	4	-	-	-	28	100	166	187	240
Hyola 650TT		-28	10	25	-	61	65	109	150	214

HyTTec Trophy has a \$10 EPR which has been accounted for in these calculations. Green shading marks profits > \$108 (1:1 rate of return) and yellow shading marks profits > \$216 (1:2 rate of return) (calculated at 4kg/ha seeding rate, \$30/kg hybrid seed, \$3kg OP seed)

Table 5. Affordability of hybrid seed (kg/ha) for 1:1 return on seed investment, above profitability of ATR Bonito, where hybrid yields were achieved at 40-50 p/m² (presumed to be seeding rates usually over 4kg/ha).

TT variety	Approx seed cost (\$/kg)	Early trial series (40p/m ²)				Mid trial series (50p/m ²)				
		0.75 t/ha	1.25 t/ha	1.75 t/ha	2.25 t/ha	1.25 t/ha	1.75 t/ha	2.25 t/ha	2.75 t/ha	3.25 t/ha
InVigor T 3510	26.50	1.9	1.7	1.8	2.3	1.5	2.3	2.5	2.8	-
Hyola 350TT	28.00	0.5	1.2	1.7	2.0	1.1	2.3	2.0	2.5	-
SF Spark TT	31.00	-	-	2.5	-	-	1.4	0.8	0.9	-
HyTTec Trophy	19.50	2.8	2.4	2.8	3.6	2.9	3.8	5.5	6.4	-
InVigor T 4510	27.50	1.7	2.1	2.4	2.9	1.7	2.8	3.8	4.4	5.9
Pioneer 44T02 TT	31.00	1.3	1.5	2.0	2.3	1.4	1.6	1.7	2.1	2.5
SF Turbine TT	31.00	1.1	1.2	1.2	1.6	0.8	1.7	2.0	1.9	2.3
Hyola 550TT	28.00	0.8	-	-	-	-	1.9	2.7	3.3	-
SF Ignite TT	31.00	-	-	-	-	0.4	2.0	3.0	3.1	4.0
Hyola 559TT	23.00	2.4	2.5	3.0	3.6	2.3	2.2	2.8	3.7	4.8
Pioneer 45T03 TT	31.00	-	-	-	-	-	1.4	1.4	1.2	-
DG 670TT	31.00	0.1	-	-	-	0.5	1.6	2.7	3.0	3.9
Hyola 650TT	23.00	-0.6	0.2	0.5	-	1.3	1.4	2.4	3.3	4.7

HyTTec Trophy has a \$10 EPR which has been accounted for in these calculations.

Conclusions

The economic model simulates the yield threshold to change from OP to hybrid TT variety at 1.2t/ha for 1:1 rate of return and 2.5t/ha for 1:2 rate of return. This is using 4kg/ha seeding rates, to approximate the actual seeding rates used in the NVT trials. We would expect similar profitability and similar thresholds with lower seeding rates, with lower costs and lower yields.

However, HyTTec Trophy and InVigor T4510 were both profitable at a 1t/ha DPIRD trial at Grass Patch in 2018 (1:2 rate of return) although there was a limited response at the 2.6t/ha trial at Cunderdin, with only a single hybrid treatment being profitable.

Opportunity awaits with hybrid TT varieties, but there is more risk involved. Try strips on-farm to calculate your own profit margins. Use your own situation to decide when to grow hybrids. Consider your business risk profile, opening rains and season outlook, expected hybrid performance, seed cost, seed size and your own experiences.

Otherwise, we recommend using hybrid TT varieties when the 1:2 return is reasonably reliable (>2t/ha) then using seeding rates to target optimal crop densities of 25-50p/m², according to rainfall zone (French et al, 2019). This approach would reduce overall financial and production risk.

Key words

Canola, Varieties, Hybrid, open pollinated (OP), Triazine tolerant (TT), Roundup Ready (RR), Glyphosate tolerant (GT), and Clearfield (CL)

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