Growing hybrid canola

With good management, hybrid canola offers growers in the medium and high-rainfall zones the potential to increase yield. However, the balance between increased seed price, yield and grain price needs to be assessed.

KEY POINTS

■ On average, hybrid canola yields around 11 per cent more than in-bred open-pollinated varieties in Australia.

■ In 2010, around 40 per cent of canola seed sales in Australia were for hybrids; a massive increase in adoption over previous years.

■ Check National Variety Trial results for the best variety choice for your region, which may or may not be a hybrid – www.nvtonline.com.au

■ The cost of seed for hybrids is more than double that of open-pollinated varieties due to high costs of seed production.

■ On average, 10 per cent more hybrid canola seed establishes as plants compared with open-pollinated varieties.

■ The expected yield benefit from hybrids over open-pollinated varieties should cover the increased seed cost, to make a hybrid worthwhile.

■ Growing hybrid canola in the high and medium-rainfall zones and under irrigation carries less risk than in the low-rainfall zone.

■ The management and marketing of hybrids is mostly the same as open-pollinated varieties.

■ Hybrid canola is ideal for graze and grain or for fodder conservation as it generally produces more biomass than open-pollinated varieties.

■ Second-generation hybrid seed should never be retained for sowing.

What is a hybrid?

A hybrid is a plant created by cross-pollinating male and female in-bred parents. A hybrid has the benefit of ‘hybrid vigour’. Canola breeders aim to improve certain traits, such as increased yield, oil content, disease resistance and uniformity.

Like traditional open-pollinated (OP) canola varieties, hybrid canola can be bred using non-GM and GM techniques and varieties can include herbicide tolerance (Table 1). In recent years, breeders have combined herbicide tolerance, early vigour, blackleg resistance, good stem strength and improved yields into hybrid canola, leading to a major increase in adoption in Australia.

Differences between hybrid and open-pollinated canola

■ Hybrid canola generally has a higher yield potential than in-bred OP varieties. This improved yield is achieved through a combination of superior traits, such as larger seeds assisting with early vigour and better stress tolerance.

■ The early vigour of hybrids provides competition with weeds.

■ Hybrid varieties have more even maturity allowing for easier harvest.

■ Hybrids can produce more biomass, making them a better choice for grazing when grown as a dual-purpose crop.

■ Seed of hybrid varieties is around two-and-a-half times more expensive than OP canola seed.

■ Hybrid seed should never be retained for sowing as it will not produce true copies of the original hybrid plant.
Sowing and establishment of hybrid canola

Selecting a canola variety

After deciding to grow canola, the next choice is which herbicide tolerance type to grow. This decision should be based on the weed spectrum in the paddock in most situations.

Local trial results, including National Variety Testing (NVT) data should be used to then determine the most appropriate variety, which may or may not be a hybrid. NVT data can be found on www.nvtonline.com.au.

In 2009, NVT sites in Western Australia, Victoria and New South Wales where all herbicide tolerance types were included, the average yield of hybrids was around 11 per cent more than open-pollinated varieties (Table 2).

Triazine tolerant OP canola varieties are most popular in Australia, but generally the lowest yielding. In 2009, the top yielding herbicide tolerant hybrid at a given site out-performed the top triazine tolerant OP variety at that site by 14 per cent, when averaged over all sites. The top yielding herbicide tolerant hybrid significantly outyielded the top performing triazine tolerant OP variety at six of the 11 sites; the yield benefit ranged from 13 to 27 per cent. For the remaining five sites, there was no significant difference.

Oil content of current hybrids is similar to OP varieties. Triazine tolerant varieties tend to have lower oil content.

Never retain hybrid seed

Only the F1 hybrid seed provides the benefits of hybrid vigour. If the harvested grain is retained for seed, the crop grown from the second generation (F2) will be inconsistent. This is because it will contain some traits from each of the original parent lines which were crossed to create the F1 hybrid.

The amount of variability in the F2 will depend on how great the difference was between the original two parent lines. Big differences can occur between individual plants in traits such as blackleg resistance, height, maturity, yield and even herbicide tolerance. One in four F2 plants will also be ‘male sterile’, requiring ideal conditions during flowering for cross-pollination otherwise yields will be further reduced.

### Table 1

When growing canola there are many choices. Conventional and herbicide tolerant hybrids are available in Australia. Of these only the Roundup Ready® hybrids are genetically modified. Some high stability canola oil varieties are also hybrids. The inclusion of Hyola, HT or Y in the name indicates the hybrid canola varieties of Pacific Seeds, Canola Breeders and Pioneer Hi-Bred respectively.

<table>
<thead>
<tr>
<th>Type</th>
<th>Herbicide tolerance</th>
<th>Pollination type</th>
<th>Oil quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canola (Brassica napus)</td>
<td>None (conventional)</td>
<td>OP (open pollination)</td>
<td>Canola quality</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hybrid</td>
<td>Canola quality</td>
</tr>
<tr>
<td></td>
<td>CLEARFIELD®</td>
<td>Hybrid</td>
<td>High stability</td>
</tr>
<tr>
<td></td>
<td>OP</td>
<td>Canola quality</td>
<td></td>
</tr>
<tr>
<td>Triazine tolerant</td>
<td>OP</td>
<td>High stability</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hybrid</td>
<td>Canola quality</td>
<td></td>
</tr>
<tr>
<td>Roundup Ready®</td>
<td>OP</td>
<td>Canola quality</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hybrid</td>
<td>Canola quality</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High stability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juncea canola (B. juncea)</td>
<td>CLEARFIELD®</td>
<td>OP</td>
<td>Canola quality (juncea)</td>
</tr>
</tbody>
</table>

How hybrids are made

Four systems for producing canola hybrids are used commercially worldwide.

The two systems currently used for the triazine tolerant hybrids differ from that used to create Roundup Ready® and CLEARFIELD® hybrids. InVigor® hybrids, which are not currently available in Australia, are generated with a fourth system.

Hybrid canola seed production aims to produce seed with hybrid vigour from the first cross of two distinct parent varieties; it is a labour intensive and expensive process.

The ‘female’ parent, which produces the hybrid seed, is male sterile; that is, its flowers have no pollen. This ensures seed is only produced by out-crossing with another ‘male’ as it cannot self-pollinate. Bees are used to help cross-pollinate the ‘female’ flowers.

The male and female plants are grown in rows, and the male plants are removed after flowering, so only about 60 per cent of the paddock area produces hybrid seed.

The resulting seed that is harvested from the female plants is the first cross, or ‘F1’ hybrid seed. Seed produced by hybridisation has the benefit of hybrid vigour when compared with seed from normal OP canola varieties.

The F1 seed will grow into plants that have pollen in their flowers. This is because the original male parent has a ‘fertility restorer gene’ which is carried by all F1 seeds.

![A fertile male canola flower (above) used to cross with a ‘male sterile’ flower (below) of female canola which produces hybrid seed.](image)
Blackleg resistance

The blackleg resistance rating of canola depends on the variety. It is important to check blackleg resistance ratings each year (www.australianoilseeds.com). One of the reasons seed from hybrids should not be retained for sowing is that the risk of blackleg can increase substantially (Table 3).

Paddock selection

To gain the most from the crop and to minimise financial risk, first time hybrid canola should be grown on paddocks with the highest yield potential. Hybrid canola carries the least production risk, and therefore financial risk, in the high and medium-rainfall zones and when grown under irrigation.

The requirements for growing Roundup Ready® hybrids are the same as Roundup Ready® OP varieties.

Desired plant densities

Research is continuing to determine optimal plant densities for hybrid canola. Density may be less than OP varieties due to the excellent vigour and biomass production of hybrids as well as the higher cost of seed. However, the uniformity of plant density over the paddock is more important than the average plant population.

Trials have shown:

- very low plant densities (below 20 plants per metre square) can reduce hybrid canola yields and increase risks of patchy establishment and uneven crops;
- to date no economic benefit has been shown from increasing hybrid populations above 40 plants per metre square in most cases, but more research is being undertaken;
- high plant densities (around 65 plants per metre square or more) have been shown to maximise yields in some high-rainfall sites. The cost of hybrid seed usually negates this benefit; and
- high plant densities can increase biomass production.

Sowing rates for hybrid canola

The only difference in input costs between an OP variety and a hybrid is the seed. Hybrid seed is around twice as expensive and sowing rates may need to be higher, so the yield benefit must be sufficient to compensate for this.

The crop will need to yield at least 50 kilograms per hectare more for every extra kilogram per hectare of seed to recoup the additional seed costs when canola is priced at $450 per tonne and hybrid canola seed is $23 per kilogram. Accurate seeder calibration is extremely important for all canola varieties, but particularly for hybrids where seed size of individual seed lots can vary.

Hybrid canola seed can be almost twice as large as OP seed, therefore contains less seeds per kilogram – ranging from 150,000 to 240,000; compared with 250,000 to 320,000 for OP varieties. Seed size depends on the hybrid and seed lots and the number of seeds per kilogram is provided with the bag of seed.

Hybrid canola seed generally has about a 10 per cent higher establishment rate than OP canola. The expected establishment rate depends on conditions at sowing time and the minimum germination percentage printed on the bag, which will be at least 85 or 90 per cent, depending on the seed.

It is common for only 50 per cent of canola seeds to establish into plants in less than ideal conditions, but this can be as high as 80 to 90 per cent for many hybrid crops in optimal conditions.

**TABLE 2** Average yields in tonnes per hectare and oil content in percentage of hybrids and OP varieties in 2009 NVT trials in WA, Victoria and NSW at 11 sites. These were the only sites where all three herbicide tolerance groups were included. The yield benefit of hybrids over OPs is shown, as a percentage.

<table>
<thead>
<tr>
<th>Hybrid</th>
<th>Source</th>
<th>Average YIELD ALL SITES (11 sites)</th>
<th>Average OIL CONTENT ALL SITES (11 sites)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TT hybrids (2 varieties)</td>
<td>1.86 t/ha</td>
<td>38.5%</td>
<td></td>
</tr>
<tr>
<td>TT OP varieties (11)</td>
<td>1.79 t/ha</td>
<td>39.9%</td>
<td></td>
</tr>
<tr>
<td>RR &amp; CL hybrids (8)</td>
<td>2.10 t/ha</td>
<td>40.7%</td>
<td></td>
</tr>
<tr>
<td>RR &amp; CL OP varieties (5)</td>
<td>1.99 t/ha</td>
<td>40.6%</td>
<td></td>
</tr>
<tr>
<td>ALL hybrids (10)</td>
<td>2.06 t/ha</td>
<td>40.3%</td>
<td></td>
</tr>
<tr>
<td>ALL OP varieties (16)</td>
<td>1.85 t/ha</td>
<td>40.1%</td>
<td></td>
</tr>
<tr>
<td>AVERAGE HYBRID YIELD BENEFIT</td>
<td>11%</td>
<td>SIMILAR OIL CONTENT</td>
<td></td>
</tr>
</tbody>
</table>

Note: Eight varieties that were not sown in all 11 trial sites were removed for a balanced comparison. WA sites: Dudinin, Mt Barker, Gibson; Victoria: Horsham, Shepparton, Hamilton, Teesdale; NSW: Culcairn, Cullina, Greenethorpe and Mbitulen. Check local NVT data for details. TT indicates triazine tolerant; RR indicates Roundup Ready® and CL indicates CLEARFIELD®.

**TABLE 3** Seedling vigour was reduced in two of four hybrids and plant death from blackleg was higher in all four hybrids when farmer-retained seed was used in a trial at Dunkeld, Victoria, in 2009. Seedling vigour was measured by ranking of individual plants from one to four.

<table>
<thead>
<tr>
<th>Hybrid</th>
<th>Seed source</th>
<th>Seedling vigour (1 to 4)</th>
<th>Plant death from blackleg (percentage of plants)</th>
</tr>
</thead>
<tbody>
<tr>
<td>46Y78</td>
<td>Commercial</td>
<td>3.7</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Retained</td>
<td>1.3*</td>
<td>39*</td>
</tr>
<tr>
<td>Hyola 76</td>
<td>Commercial</td>
<td>2.0</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Retained</td>
<td>2.0 ns</td>
<td>22*</td>
</tr>
<tr>
<td>Hyola 50</td>
<td>Commercial</td>
<td>2.3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Retained</td>
<td>1.3*</td>
<td>32*</td>
</tr>
<tr>
<td>Hyola 571CL</td>
<td>Commercial</td>
<td>2.0</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Retained</td>
<td>1.3 ns</td>
<td>12*</td>
</tr>
</tbody>
</table>

* Indicates a significant difference between retained and commercial seed of each hybrid. ‘ns’ indicates no significant difference. Note: yields were also reduced in plots with retained hybrid seed, but were low (0.50 to 0.75 tonnes per hectare) due to severe spring waterlogging. Source: Better Oilseeds
To calculate canola sowing rate:

Sowing rate in kilograms per hectare = \frac{(target~plants~per~metre~square \times 1,000,000)}{(seeds~per~kilogram \times expected~establishment~percentage)}.

For example, for a hybrid with 195,000 seeds per kilogram in a medium-rainfall zone with good seedbed moisture, assuming 70 per cent establishment:

Sowing rate = \frac{(40~plants~per~metre~square \times 1,000,000)}{(195,000~seeds~per~kilogram \times 70~per~cent~establishment)} = 2.9~kilograms~per~hectare.

Growing and using hybrid canola

Canopy management

Some canola hybrids can grow tall and bulky in high-rainfall situations or under irrigation, particularly with early sowing, high sowing rates, and high nitrogen rates. High rates of nitrogen applied before and at sowing can lead to bulky crops potentially more at risk of lodging or, in a dry finish to the season, haying off. Topdressing all or splitting nitrogen applications can help manage the bulkiness of the crop. Research has shown that as long as there is at least 40 kilograms per hectare, or units, of available nitrogen in the top 50 centimetres at sowing, there is generally no yield penalty associated with delaying or splitting nitrogen applications. Grazing canola in winter can also reduce the bulkiness of hybrids, and can be successful under certain conditions.

Windrowing and harvest

The more even maturity of hybrids may reduce shatter losses compared with OP varieties. Canopy management methods, such as grazing, can help reduce height and bulk of some hybrids to allow for easier harvest.

Delivery and marketing

The delivery and marketing of hybrid canola is no different to OP varieties. The requirements for Roundup Ready® hybrids are the same as for Roundup Ready® OP varieties.

Post-harvest volunteer weed control

Volunteer F2 hybrid canola plants can be controlled in the same way as volunteer OP canola plants of the same herbicide tolerance group.

Grazing and fodder conservation with hybrid canola

Dual-purpose canola

Dual purpose canola (for grazing and grain production) is best suited to the high-rainfall zones, with drier regions carrying a higher risk of a failed crop. The higher biomass production of hybrids, compared with OP varieties of similar maturity, makes them an appropriate choice for dual purpose canola. For example, heavy grazing by sheep removed an average 1.6 tonnes per hectare of biomass from hybrids but only 1.0 tonne per hectare from OP varieties in a trial at Young, NSW, in 2009. The results were for Clearfield®, Roundup Ready® and conventional varieties. However, triazine tolerant varieties provided much less biomass, with no boost in biomass with hybrids; 0.5 and 0.6 tonnes per hectare was removed for hybrids and OP varieties, respectively. The crop can be sown two or three weeks earlier than normal, in early to mid April, potentially resulting in significant biomass – around two to three tonnes per hectare by mid-winter to fill the winter feed gap. Mid to mid/late maturing types for the area are best suited to an earlier sowing.

Canola hay and silage

Canola crops can be cut for hay or silage if the returns are likely to be greater than taking the crop through to grain harvest. Hybrids produce more dry matter than OP canola types so will produce the most hay or silage for a given cutting time. Cutting canola at early flowering produces the best quality hay, but cutting at late flowering to early pod fill is the best compromise between yield and quality – and the most profitable option.

Useful resources:

- Canola best practice management guide for south-eastern Australia
- Raising the bar with better canola agronomy
- Over the bar with better canola agronomy
- Dual-purpose crops fact sheet
- Hybrid technology, the ultimate in canola performance
  - www.pacificseeds.com
- Focus on Canola newsletters
  - www.australia.pioneer.com/Products/Canola/tabid/57/Default.aspx
- Australian Oilseeds Federation
  - www.australianoilseeds.com
- Canola Breeders Western Australia
  - www.cbwa.net.au
- National Variety Testing
  - www.mvtonline.com.au
- CAA Blackleg Resistance Ratings 2010
- Canola Association of Australia
  - www.australianoilseeds.com/commodity_groups/canola_association_of_australia

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