Canola and mustard in the northern region: an update on research progress

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Abstract

We outline research progress on canola and mustard agronomy and variety selection for northern NSW and southern Qld. We discuss variety performance, relative performance of Indian mustard over canola in dry environments, the prospects for producing high quality canola reliably in the region, and phosphorous nutrition. We end with a statement of future research priorities for the crop in the northern wheat-belt.

Introduction

At the 2001 ARAB meeting we reported on a recent resurgence in canola production in northern NSW and southern Queensland (Holland et al. 2001). Between 1998 and 2001 there had been strong growth in the canola area, particularly in north-west New South Wales, accompanied by a notable increase in yield per hectare (Holland et al. 2001). In 2003, there is an estimated 11,000 ha of canola sown in the northern region, and about 400 ha mustard. This is the first record of mustard in the north. It appears that growers are adopting the crops and see a role for them in their farming system. Survey data by us (Holland et al. 2001) and anecdotal evidence suggests that this has been mostly driven by the pressures of disease and weed problems in wheat-based systems. As canola and mustard are relatively new crops to the region there are a number of varietal and agronomic issues to be addressed to ensure reliable production. This paper reports on progress on research on a number of these fronts.

Canola variety performance

Experiments in the north have allowed the identification of superior genotypes with good adaptation to the region. Significant yield improvements are obvious. As an example of this, the variety Monty was a popular early maturing variety in the late 1990s, but in 2001, it was out-yielded by the newly released Rivette by 18%. As well, we have identified several lines, which may have specific adaptation to the north. These include the early maturing BLN2017 and mid-season BLN2372. We have made single plant selections under moisture stress conditions at Coonamble, in the western part of the region, and this material is currently under test.

There are an increasing number of hybrids appearing in genotype experiments, and at this early stage they are showing promise, particularly amongst the early maturing material.

Triazine-tolerant (TT) varieties and Clearfield\textsuperscript{®} types are becoming more popular in the region. Triazine-tolerant varieties carry a yield penalty, whereas Clearfield\textsuperscript{®} does not. There can also be a seedling vigour problem with triazine-tolerant varieties, and it may be necessary to select for increased vigour for use in no-till situations.

Performance of Indian mustard

It has been suggested that Indian mustard (\textit{Brassica juncea}) may have a special role in northern environments due to its adaptation to high temperature and water deficit (Oram et al. 1999; Wright et al. 1995). In a recent analysis of time of sowing studies conducted by us (Robertson et al. 2003) we found that yields were lower and more stable across sowing dates and locations in Indian mustard compared to canola. Much of the reason for this was the low harvest index of the Indian mustard, which never exceeded 0.22, while in both cultivars of canola it varied between 0.14 and 0.38. It was anticipated that the Indian mustard may have yielded more than the canola, particularly in low-yielding situations, as found by Wright et al. (1995). In our study Monty, Oscar and Indian mustard were compared in six sowings. In only one of these sowings, (26th May 1999 at Roma), did the Indian mustard out-yield either of the canola cultivars (102 v. 84 g/m\textsuperscript{2} in both Monty and Oscar). In two other
sowings (10th July 1999 at Roma, 18th August 1999 at Tamworth), where yield levels were even lower, the Indian mustard did not yield more than either of the canola cultivars.

A similar picture emerges in data shown in Figure 10. While there is a trend for earlier flowering to be associated with higher yield in these marginal environments, the Indian mustards only out-yielded the canolas at an equivalent time of flowering on one occasion (Melvin). On the other three occasions, Indian mustards yielded similarly to canolas that flowered at a similar time.

In other experiments, mustard has clearly shown advantages under drought or high temperature stress conditions. In 2000, when there was a hot and dry period during flowering in September, we obtained the yields of canola, mustard and wheat in two separate experiments (Table 25).

The mustard out-yielded the canola by 15% at Loomberah and 24% at Tamworth with adequate phosphorus nutrition. In these experiments, when phosphorus was not applied, the mustard out-yielded the canola by 32% and 88% at Loomberah and Tamworth respectively (data not shown).

In 2001, well-adapted mustard lines (887.1.6.1 and JN028) out-yielded canola varieties by over 50% at Coonamble in the very dry conditions (1.1 t/ha from mustard compared with 0.7 t/ha from canola).

The oil content of the mustard was lower (36.3% from mustard compared to 39.5% from canola), but total oil production per hectare was still 42% higher from the mustard. At higher yielding sites at Tamworth and Moree, yields were similar from canola and mustard and oil from mustard was about 1% lower than canola. In 2002, under drought conditions at Tamworth, mustards again out-yielded canola check varieties by about 50%.

Overall, there is a trend for mustard to outyield canola under low yielding conditions, but for the difference to disappear under normal seasonal conditions. Mustard also performs better under low phosphorus conditions than canola.

Condiment mustard was assessed at Tamworth in 2002, and the commercially released varieties Mickey and Kay gave the highest yield in the experiment.

![Table 25: Yield (t/ha) of canola, mustard and wheat in 2000 with 20 kg/ha P.](image)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Loomberah black soil</th>
<th>Tamworth red soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>canola</td>
<td>1.95</td>
<td>1.65</td>
</tr>
<tr>
<td>mustard</td>
<td>2.24</td>
<td>2.05</td>
</tr>
<tr>
<td>wheat</td>
<td>4.33</td>
<td>2.58</td>
</tr>
</tbody>
</table>

How reliable is high quality canola production in the north?

Despite the increasing area of the crop in the north-eastern wheat-belt, there is little information on yield expectations of canola in relation to rainfall location and soil type. The north-eastern wheat-belt is characterised by high rainfall variability, high temperature during grain-filling and yield-damaging frosts in spring (Robertson et al. 2001). In addition, in contrast to southern and western Australia growing regions, winter crops in the north-eastern wheat-belt have a stronger dependence on stored soil water for growth and the importance of this for the...
reliability of canola production in the north-eastern wheat-belt is unknown. We have conducted simulations with the APSIM model coupled to long-term climate data for key northern locations to assess the degree of variability in yield and oil content. Simulations assumed adequate nitrogen, an early-mid maturity cultivar and sowing date dependent upon rainfall. Estimates of oil content were based on a new prediction equation that accounts for temperature and water stress during grain filling (Robertson and Holland 2003). The results emphasise the importance of building up good soil water reserves before sowing canola. At Walgett canola production will be marginal if less than 100 mm soil water is available at sowing, and even then in 50% of seasons yields will not exceed 1.2 t/ha.

Simulations for oil content gave median oil contents of 38, 39, 40 and 42 for Roma, Walgett, Moree and Gunnedah, respectively. The cut-off for the bonus/penalty in grain price for canola is currently 42%. The probability of exceeding this cut-off was 0.25, 0.40, 0.40 and 0.55 for Roma, Walgett, Moree and Gunnedah, respectively. This emphasises the difficulty that canola growers face in the north-eastern wheat-belt in producing canola grain of high oil content that will attract a price bonus. This challenge is particularly strong in the higher-temperature northern locations, such as Roma.

An analysis of canola yield and oil content (and therefore gross margin) in years with different phases of the SOI in autumn (Table 26) shows that when the SOI is consistently negative or falling, yield and oil content will be on average lower. The reverse is true in years when the SOI is consistently positive or rising. This suggests that the choice to sow canola over other, less-risky alternatives could be a tactical decision that depends upon the seasonal climate outlook.

Response to phosphorous

In 2001 we documented large responses of canola to phosphorus in experimental and commercial situations where growers would not normally have planned on applying phosphorus (Holland et al. 2001). Experimental work since then has shown that canola is responsive to phosphorus inputs in situations where wheat would not normally require phosphorus (Figure 13).

There is evidence that grain yield will respond positively up to soil surface phosphorus test values of 15–20 mg/kg. With the cost of phosphorus at around $3/kg phosphorus, yield increases are economic. Interestingly, there is some evidence that oil content improves in very phosphorus-responsive situations, but can decrease in non-responsive situations.

Conclusions

Canola is becoming accepted in the north-eastern region of Australia. Improved varieties and a better understanding of agronomic needs have assisted this development. Well-adapted mustard varieties would appear to have a role in the drier and warmer parts of the region with their superior drought resistance characteristics. The canola quality mustard industry is still awaiting the release of suitable varieties. Condiment mustard is being commercially grown in the region for the first time this year, with prospects for a new industry to develop.

In the future, there should be more emphasis on selecting herbicide tolerant (TT and Clearfield®) canola genotypes adapted to the north. Mustard genotypes, both canola quality and condiment types, will require further evaluation if we are to base new industries on these. Viruses will require management strategies to minimise their impact on mustard. We need to check the nutrition status of our crops, particularly for phosphorus, sulphur and zinc on our alkaline soils. The rotational implications of canola and mustard still need refining.
Table 26: Long term average (1990–2002) simulated grain yield, oil content and gross margin by April-May SOI phase for Moree. Simulations assumed 100 mm available soil water at sowing.

<table>
<thead>
<tr>
<th>SOI phase</th>
<th>Number of years</th>
<th>Grain yield (kg/ha)</th>
<th>Oil content (%)</th>
<th>Gross margin1 ($/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>16</td>
<td>1449</td>
<td>39.0</td>
<td>77</td>
</tr>
<tr>
<td>Positive</td>
<td>22</td>
<td>1797</td>
<td>40.7</td>
<td>86</td>
</tr>
<tr>
<td>Falling</td>
<td>14</td>
<td>1289</td>
<td>38.1</td>
<td>82</td>
</tr>
<tr>
<td>Rising</td>
<td>26</td>
<td>1898</td>
<td>40.6</td>
<td>100</td>
</tr>
<tr>
<td>Zero</td>
<td>25</td>
<td>1741</td>
<td>40.2</td>
<td>101</td>
</tr>
<tr>
<td>All years</td>
<td>103</td>
<td>1686</td>
<td>39.9</td>
<td>91</td>
</tr>
</tbody>
</table>

1 assuming a grain price of $350/t

Figure 12: Cumulative distribution functions of grain yield for different levels of available soil water at sowing for a reliable (Gunnedah) and marginal (Walgett) canola production area in northern NSW. Each curve is composed of 103 simulated seasons (1900–2002).

Figure 13: Relationship between soil P status and the response of canola yield and oil content to P fertiliser (10–20 kg P/ha). Data are from a range of on-station and on-farm experiments in the northern region.
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References


