Canola and mustard in northern NSW

Summary
This project has contributed significantly to the understanding of canola and mustard agronomy in northern New South Wales (NSW). This work has involved the identification of well-adapted genotypes and a better knowledge of their agronomic requirements and their role in northern farming systems. Selections of early maturing canola lines were taken at the project’s western sites, and these have been included in later generation experiments, such as the Stage 3 experiments. One line, BLN3303*CR0302, looks quite promising in the 2006 season. Early selections of condiment mustard were also taken from the well-adapted variety Micky, and one (Selection 2) is in seed increase with prospects of release in 2007.

Report Disclaimer
Conclusions

1. Canola is well-adapted to northern NSW in the higher rainfall areas of the Liverpool Plains and east of Moree.
2. Mustard is well-adapted to the western parts of northern NSW, including the Coonamble, Walgett, and west Moree districts.
3. Both canola and mustard are quite effective in reducing crown rot (CR) severity in following wheat crops.
4. Sclerotinia is only a minor problem in canola and mustard in northern NSW. Beet western yellows virus (BWYV) is present in the region and occasionally is important in mustard. Canola is relatively unaffected by this disease in northern NSW.
5. The zinc (Zn) and sulphur (S) status of canola crops appears to be adequate.
6. On the basis of one frost study, mustard is more sensitive to frost damage than canola. However, field observations have shown a range of responses—in one case indicating canola more sensitive to frost damage than mustard, and the opposite result in another case. More work needs to be done to clarify these results.
7. Little evidence was found of deleterious effects of canola or mustard on grain sorghum or mungbeans sown soon after brassica harvest.

Recommendations

1. Further genotype improvement is required for canola. In particular, the further development of hybrids seems justified, as their yield advantage is now approx. 20% above site mean yield. Other crops, such as sorghum, corn and sunflowers, are based around the exploitation of hybrid vigour.
2. Mustard, both juncea canola and condiment types, are at an early stage of development and further breeding and evaluation is required. Given the low input so far, rapid yield increases are anticipated. The development of herbicide-tolerant types and hybrids would be advantageous, paralleling the development of canola.
3. Further frost studies are required to assess the relative frost tolerance of canola and mustard. Perhaps growth stage affects relative responses, and could be studied under controlled conditions.
4. Agronomic studies with canola and mustard are still warranted. The benefit of sowing these crops in early April is one potentially fruitful study area.

Outcomes

Economic benefits:
Since this project began, there has been increasing interest in the farming community in growing canola and mustard in
northern NSW. This is consistent with a long term aim to increase the area sown to broadleaf crops in northern rotations to over 20% of the cropped area. In this regard, canola and mustard would complement other crops such as chickpeas, faba beans, field peas and lupins. As well as producing their own returns, there is awareness of the rotational benefit of these crops by reducing CR in following winter cereals. In this project, it has been shown that canola and mustard are very effective in this regard. The area of canola reached a peak of about 76,000ha in 2004–2005, but in 2005 and 2006, poor seasonal conditions, lack of timely planting, rain and low prices has seen the area decline. However, given normal seasons and prices, the area in future would be expected to rise to 80,000 to 100,000ha. The area of mustard has been slowly rising over the last few years, and with the potential release of several new and well-adapted varieties, it is anticipated that mustard area will increase substantially. The varieties should include Selection 2 condiment mustard (from Micky), and a release from Wayne Burton of a new juncea canola. Mustard is better adapted than canola to the lower rainfall parts of northern NSW, including Coonamble, Nyngan, Walgett and areas west and north of Moree. Mustard has a lower cost of production than canola, as its better shattering tolerance means less need for windrowing, and it has lower requirements for nutrition (particularly phosphorus (P)) and insecticides. Area of mustard could climb to between 50,000 and 100,000ha, resulting in a total brassica area of 130,000 to 200,000ha.

This project has allowed the development of better recommendations for growing canola and mustard in northern NSW, and the identification of well-adapted genotypes.

Environmental and social outcomes:
Canola and mustard have their traditional uses, but in the future, they may both also be used for biodiesel production. With growing awareness in the community of the need to reduce carbon dioxide emissions from fossil fuels, the use of biodiesel should gain acceptance more widely in the community. Already, there has been some interest in setting up small to medium-sized extraction plants, particularly in western areas based on mustard, which could have favourable social consequences by creating local employment.

Achievements/Benefits

Canola genotype improvement:
A total of 95 canola genotype experiments have been sown over the three years of the project, on sites ranging from Tamworth, Breeza, Moree, Walgett and Coonamble. These have been at levels ranging from early selection trials to advanced stages. In 2003 and 2004, experiments were conducted up to Stage 4, and data from these experiments were published in the NSW Department of Primary Industries (DPI) publication ‘Canola: New South Wales planting guide 2006’. In 2005, Stage 1, Stage 2 and Stage 3 experiments were conducted.

From the Stage 1 experiments, several promising new lines have been identified. A selection taken at Walgett named BLN3303*CR0302 has been yielding very well up to and including the 2006 season, and is a potential early maturing release. This project has also contributed to the identification of other varieties which have yielded well in the northern region. Included amongst these are Skipton(T), Tarcoola(T), Outback(T), 44C73, Hyola 75(T), Rivette(T) and Spectrum.

Along with these aspects, this project has also had a role in identifying superior parents. For example, BLN2448*COO0108, selected at Coonamble, has been identified at Wagga as a successful parent (Neil Wratten, pers. comm.).

Mustard genotype improvement:
Significant progress has been made in the development of a mustard industry in northern NSW during the last three years. There are a number of potential markets for mustard crops, and this project has been instrumental in developing genotypes to meet some of these markets. Two distinct types of mustard have been evaluated: those possessing canola quality (referred to as juncea canola) and condiment mustard types. These two types have been evaluated in separate experiments, but canola varieties were included to obtain a relative performance measure.

Condiment mustard: Over the seasons 2003-2005 14 condiment mustard experiments were conducted. Micky was identified, as a well an adapted variety. Permission from CSIRO was obtained to take single plant selections from Micky and this was done in 2003. Since that time, the selections have been narrowed down to three, which are referred to as Selection 1, Selection 2 and Selection 3. Over 2004 and 2005, Selection 2 was the highest yielding among these, and was also earlier and shorter than Micky. As a result, Selection 2 is in seed increase in the 2006 season with prospects of release in the future. Data from the 2005 season are shown at the end of this section.

Juncea canola: Over the three seasons of 2003-2005, 14 juncea canola experiments were conducted, in close collaboration...
with Wayne Burton of VIDA, Horsham. The project has helped to identify well-adapted material, and particularly JR055, which is likely to be released to growers in 2007. This contains the quality parameters of canola (oleic acid above 60%, low glucosinolate) but is well-adapted to the western parts of the region where its drought resistant characteristics and shelling resistance frequently give it an advantage over canola. At high yield levels (e.g. over 1.5 tonnes/ha) canola usually outyields mustard and would be the preferred crop.

Survey of commercial crops for S and Zn status:
Earlier work identified nitrogen (N) and P as the main nutrient deficiencies in northern NSW for canola and mustard. As a follow up to this work, 38 commercial crops of canola were surveyed for possible deficiencies of S and Zn. Crops were leaf sampled at early flowering and analysed for S and Zn status. Using standard critical levels from Reuter and Robson (1997) for foliar analysis, crop Zn levels equalled or exceeded the critical range of 15–17ppm in all cases. The lowest level recorded was 17ppm. With S, the crop leaf levels always exceeded the critical range of 0.26–0.36% S. The lowest level recorded was 0.38%. These results indicate that neither Zn nor S deficiencies are a serious limiting factor for canola yield in northern NSW.

Disease and insect experiments in canola and mustard:
In 2003 and 2004, canola and mustard were assessed for incidence of sclerotinia in association with Tamrika Hind-Loiselet at Tamworth. In the same experiment, Rovral® fungicide treatments were imposed at early flowering, late flowering or at both stages, as well as a nil control. Incidence of sclerotinia was low in both seasons, and there were no yield responses to the fungicide in either crop.

In 2003, 2004 and 2005, experiments were conducted to evaluate the effect of insecticide on canola and mustard to assess any impact on repelling aphids and so minimising viral diseases carried by the aphids. This work was done with Mark Schwinghamer and Adrian Nicholas. The insecticide did not affect yield, but did affect insect numbers in one experiment. In the 2004 experiment, canola and mustard were sown at Bellata to assess prevalence of aphid species, important for the spread of viruses in these crops. Aphids were mainly Liaphis pseudobrassica (turnip aphid) and Acrythosiphon kondoi (blue green aphid). Beet western yellows virus (BWYV) was the main virus present.

In the 2005 experiment at Tamworth, an insecticide (imidacloprid®) was applied to two varieties of canola and two varieties of mustard. One variety of each crop was low in glucosinolate, and the other high. Insecticide did not affect yield in any crop or variety, but different crops and varieties had significantly different numbers of insects present. Fewer heliothis caterpillars were present on the high glucosinolate mustard than the low glucosinolate mustard or canolas e.g., on 1 November 2005, there were about 50 caterpillars per square metre on canola, compared with 40 on the low glucosinolate mustard and 23 on the high glucosinolate mustard, which was Micky. Fewer aphids, mainly cabbage aphid (Brevicorme brassicae), were present on mustard than canola, and more were present on Ag-Outback® canola than Mystic® canola. Under low yielding conditions, Micky mustard outyielded the mean of the two canola varieties by 60% (1,180 vs 740kg/ha).

Frost tolerance of canola and mustard:
In northern NSW, frost is the main factor influencing grower’s choice of time to sow canola and mustard. It is important to know the relative frost tolerance of canola and mustard (and wheat as a well researched comparison crop) to help frame time of sowing recommendations. To help achieve this, a frost study was conducted in a frost facility at the Tamworth Agricultural Institute in 2005. One variety each of canola, mustard and wheat were grown in a glasshouse and exposed to frost levels ranging from -2.3 to -9.2°C plus an unfrosted control. Evidence from this experiment indicates that canola has more frost tolerance than mustard, as mustard yield was almost halved at the first level of frosting, whereas canola yield was only reduced by approx. 10%, and wheat yield was unaffected. At the second level of frosting (-3.1°C), the canola yielded twice that of mustard. Data from this experiment are shown at the end of this section.

Effect of canola and mustard on following summer crops:
Six experiments (two per season) have been completed and data analysed. Overall, there was not a large effect of prior crop (canola, mustard or wheat) on the establishment of following mungbean or sorghum. In only two cases out of fourteen measurements dry matter was affected, and in both cases more was produced on wheat stubble than brassica stubble. In only one instance was grain yield affected, and better moisture under wheat stubble in dry seasonal conditions may have been the cause. In summary, there was little evidence of adverse effects of brassica stubbles compared with wheat stubble on following summer crops.

Effect of frost on canola, mustard and wheat:
Frost treatments were imposed at the late flowering/early grain fill stage of canola and mustard and early grain fill stage of wheat. The grain yields (g/plot) of each minimum temperature treatment are shown below:

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Canola</th>
<th>Mustard</th>
<th>Wheat</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 (unfrosted)</td>
<td>18.9 17.2 11.5 3.1 1.5</td>
<td>17.2 9.5 5.6 2.2 1.3</td>
<td>24.1 26.2 19.7 3.6 1.2</td>
</tr>
<tr>
<td>T2 (-2.3C)</td>
<td>17.2 16.1 10.5 3.0 1.2</td>
<td>9.5 5.6 2.2 1.3</td>
<td>26.2 24.3 19.7 3.6 1.2</td>
</tr>
<tr>
<td>T3 (-3.1C)</td>
<td>11.5 9.3 5.5 2.1 1.0</td>
<td>5.6 2.2 1.2</td>
<td>19.7 17.5 13.7 3.6 1.2</td>
</tr>
<tr>
<td>T4 (-5.3C)</td>
<td>3.1 2.0 1.1 0.4 0.2</td>
<td>2.2 1.2</td>
<td>3.6 3.3 2.5 1.2</td>
</tr>
<tr>
<td>T5 (-9.2C)</td>
<td>1.5 1.0 0.5 0.1 0.0</td>
<td>1.3</td>
<td>1.2</td>
</tr>
</tbody>
</table>

These data indicate that canola is less affected by frost than mustard, in contrast to some field observations e.g. mustard yield fell by 45% from the control to T2, whereas canola yield fell by approx. 10%, and wheat was unaffected. At T3, mustard had fallen 67%, whereas canola had only fallen by approx. 40%.

Survey of commercial crops for S and Zn status:

A total of thirty eight crops were sampled and analysed for S and Zn status. Youngest mature leaf samples were taken at stem elongation to early flowering. N was also analysed on these samples. Results are summarised below.

<table>
<thead>
<tr>
<th>S (%)</th>
<th>Zn (ppm)</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean 0.73 33 5.1</td>
<td>Highest recorded 1.30 62 6.4</td>
<td>Lowest recorded 0.38 17 3.7</td>
</tr>
</tbody>
</table>

Reuter and Robson (1997), in Plant Analysis, an Interpretation Manual, indicate that the critical range for S is 0.26–0.36%, and for Zn is 15–17ppm. The lowest level recorded in the survey equals or exceeds these critical ranges in both cases. The N critical level is 4.7–5.3, indicating that some of the crops had less than adequate N nutrition.

Condiment mustard:

Three condiment mustard experiments were conducted in northern NSW in 2005. Yields in t/ha are shown below.

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Coonamble</th>
<th>Rowena*</th>
<th>Tamworth</th>
<th>Mean</th>
<th>% of canola</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micky</td>
<td>1.77 1.95 1.94 1.89 118</td>
<td>1.99 1.93 1.94 1.21</td>
<td>2.19 2.14 2.01 126</td>
<td>2.19 1.99 2.01 124</td>
<td>2.19 1.99 2.01 124</td>
</tr>
<tr>
<td>Sel 1</td>
<td>1.99 1.93 1.94 1.94 126</td>
<td>1.99 1.93 1.94 1.21</td>
<td>2.19 2.14 2.01 126</td>
<td>2.19 1.99 2.01 124</td>
<td>2.19 1.99 2.01 124</td>
</tr>
<tr>
<td>Sel 2</td>
<td>1.99 1.93 1.94 1.94 126</td>
<td>1.99 1.93 1.94 1.21</td>
<td>2.19 2.14 2.01 126</td>
<td>2.19 1.99 2.01 124</td>
<td>2.19 1.99 2.01 124</td>
</tr>
<tr>
<td>Sel 3</td>
<td>1.99 1.93 1.94 1.94 126</td>
<td>1.99 1.93 1.94 1.21</td>
<td>2.19 2.14 2.01 126</td>
<td>2.19 1.99 2.01 124</td>
<td>2.19 1.99 2.01 124</td>
</tr>
<tr>
<td>JR049</td>
<td>1.51 1.29 1.59 1.46 91</td>
<td>1.51 1.29 1.59 1.46 91</td>
<td>1.51 1.29 1.59 1.46 91</td>
<td>1.51 1.29 1.59 1.46 91</td>
<td>1.51 1.29 1.59 1.46 91</td>
</tr>
<tr>
<td>JN004</td>
<td>1.39 1.34 1.75 1.49 93</td>
<td>1.39 1.34 1.75 1.49 93</td>
<td>1.39 1.34 1.75 1.49 93</td>
<td>1.39 1.34 1.75 1.49 93</td>
<td>1.39 1.34 1.75 1.49 93</td>
</tr>
<tr>
<td>JN028</td>
<td>1.54 1.33 1.91 1.59 99</td>
<td>1.54 1.33 1.91 1.59 99</td>
<td>1.54 1.33 1.91 1.59 99</td>
<td>1.54 1.33 1.91 1.59 99</td>
<td>1.54 1.33 1.91 1.59 99</td>
</tr>
<tr>
<td>JR033</td>
<td>1.43 1.46 1.60 1.57 98</td>
<td>1.43 1.46 1.60 1.57 98</td>
<td>1.43 1.46 1.60 1.57 98</td>
<td>1.43 1.46 1.60 1.57 98</td>
<td>1.43 1.46 1.60 1.57 98</td>
</tr>
<tr>
<td>99Y</td>
<td>1.52 1.65 1.75 1.62 101</td>
<td>1.52 1.65 1.75 1.62 101</td>
<td>1.52 1.65 1.75 1.62 101</td>
<td>1.52 1.65 1.75 1.62 101</td>
<td>1.52 1.65 1.75 1.62 101</td>
</tr>
<tr>
<td>J397</td>
<td>1.51 1.68 1.79 1.66 104</td>
<td>1.51 1.68 1.79 1.66 104</td>
<td>1.51 1.68 1.79 1.66 104</td>
<td>1.51 1.68 1.79 1.66 104</td>
<td>1.51 1.68 1.79 1.66 104</td>
</tr>
<tr>
<td>Canola (3 cv)</td>
<td>1.85 1.09 1.85 1.60 100</td>
<td>1.85 1.09 1.85 1.60 100</td>
<td>1.85 1.09 1.85 1.60 100</td>
<td>1.85 1.09 1.85 1.60 100</td>
<td>1.85 1.09 1.85 1.60 100</td>
</tr>
</tbody>
</table>

*a severe wind and hail storm struck this trial several weeks before harvest. Canola suffered severe storm damage, but not the mustard.

New selections (1, 2 and 3) yielded well compared to both canola and the standard variety, Micky, developed by CSIRO. These selections are earlier than Micky, and Selection 1 has higher levels of glucosinolate than Micky.

Other research

1. If production of condiment mustard does increase substantially, there is an issue with the effect of the glucosinolate remaining in the meal (after oil extraction) on palatability for animals consuming the meal. Impact on growth rates and other production parameters would also need to be monitored. To date, mustard production has not been sufficient to warrant such an investigation, but this may not be the case in the future. This aspect does not arise for canola quality mustard (juncea canola) as its glucosinolate levels are low.

2. Basic studies of frost effects on canola and mustard would clarify field observations and the glasshouse study which have conflicting conclusions. Studies which incorporated freezing treatments at different developmental stages during reproductive growth could be beneficial. Results from such a study could help to frame time of sowing recommendations for...
the two crops.

**Additional information**

