Pulses: profitable new crops for the wheatbelt

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Narrow-leafed lupins have been produced on sandy acid soils throughout the wheatbelt for more than two decades. However, the wheatbelt contains large areas of soils not suited to narrow-leafed lupins. For several years researchers have been examining alternatives to narrow-leafed lupins for these soils. Kadambot Siddique, Stephen Loss and Ian Pritchard look at production of these new grain legumes, known as pulses.

Farmers have benefited from producing narrow-leafed lupins, because they are a high value protein crop with domestic and export demand and they improve soil fertility for following crops. They also produce a valuable stubble for stock, provide opportunities for grass weed control and help break disease cycles.

Other pulse crops (grain legume crops) with similar benefits are desirable for soils where narrow-leafed lupins perform poorly. Such soils are the calcarous red-brown earths, duplex soils and shallow red earths, covering about 60 per cent of the low rainfall wheatbelt.

Research into this problem gained momentum with the formation of programs for these new pulse crops at Agriculture Western Australia and the Co-operative Research Centre for Legumes in Mediterranean Agriculture (CLIMA). The program at Agriculture Western Australia primarily focuses on applied aspects of crop management and breeding, whereas CLIMA is mainly concerned with basic research.

Markets for pulses

World pulse production is dominated by the 1.2 billion people in the Indian subcontinent. They are also the greatest consumers and importers of chickpea, lentil, field pea and several tropical pulses. Based on the present rate of population growth and improvements in the economies of these countries, the demand for pulses additional to production in the Indian subcontinent is expected to increase to 3 to 6 million tonnes per year by the year 2000.

There is also demand for chickpea, faba bean, lentil and albus lupin in the Middle East and Mediterranean regions. With the trend towards healthier eating habits, pulses are also becoming more popular in the Western World.

Australia can capture a greater share of the markets in the Indian subcontinent, since we have an excellent reputation as a supplier of quality products. However, our prices need to match those of Turkey, one of the largest exporters of kabuli chickpea and red lentil, and consistent tonnages will also be needed.

Various pulses are displayed by a wholesaler in New Delhi.

Above: Traditional dishes made with high value chickpea flour, called besan.
Western Australia is well placed geographically to benefit from pulse trade with the Indian subcontinent. In addition, we can deliver our products in December and January when local crops and those of other exporters are still in the field.

Chickpea

Chickpea is adapted to well-drained, fine-textured, neutral to alkaline soils (pH 5.0 to 9.0). Its deep rooting pattern and ability to tolerate moisture stress enable chickpea to continue seed filling for several weeks after other crops have matured. Chickpea is sensitive to transient waterlogging and low temperatures during flowering and early podding.

Desi chickpea types have small angular brown seeds. They are adapted to most parts of the wheatbelt. In recent trials, the standard desi varieties Tyson, Amethyst and Dooen yielded 0.6 to 2.8 tonnes per hectare. Although Tyson is the most widely grown variety, it flowers late for our short seasons. Yields of early-sown crops are usually limited by the abortion of flowers, caused by low night temperatures in early spring. Also, Tyson is short, it has variable yields (especially in the cool southern wheatbelt) and has small dark brown seeds not favoured by consumers.

Recently, early-flowering desi lines were introduced from the International Crops Research Institute for the Semi-Arid Tropics, India (ICRISAT). These flowered 5 to 14 days earlier than Tyson, were taller and had larger seeds and lighter seed coats. Some of these lines also set pods at low temperatures and all lines out-yielded Tyson.

In a survey of consumers in the Indian subcontinent, seeds from these new lines were preferred to those of Tyson, Amethyst or Dooen. These new lines are being evaluated further, and some may be released for commercial production in 1997-98. A limited breeding program on chickpea was started in 1992 by Dr Tanveer Khan and releases of other chickpea varieties can also be expected.

Kabuli chickpea types have large seeds with cream seed coats, and usually produce 40 to 60 per cent of desi yields in most parts of the wheatbelt. Seed size has a large effect on kabuli price. Small seeds are unsaleable, so that profitable yields are difficult to achieve in low rainfall areas. Kabuli chickpea is best in areas with 400 to 600 mm rainfall, a mild spring and deep soils, where seed filling is not cut short by moisture stress at the end of the season.

Soil types suitable for the kabuli chickpea varieties Garnet and Kaniva have been identified at Dongara and in the Avon Valley, and small industries are developing around these regions. Currently new lines are being evaluated for their ability to produce large seeds and stable yields.

Faba bean

Faba bean is one of the most drought-sensitive pulse crops and until recently it was thought to be suitable only for high rainfall regions. A recent series of trials comparing the yields of pulse crops at 13 sites that had fine-textured soils (pH 5.0 to 9.0) has suggested otherwise.

The faba bean variety Fiord produced an average yield of 1.22 tonnes per hectare in the dry year 1991 (similar to field pea), and 2.87 tonnes per hectare in the wet 1992 season (252 per cent of the field pea yield). Faba bean also tolerated transient waterlogging better than other pulse crops in 1992.

The results of time-of-sowing trials in 1993 and yields obtained in the dry season in 1994 showed that faba bean is suitable for most parts of the wheatbelt. Yields decline rapidly with delayed sowing, and early sowing is critical for low rainfall areas.

The variety Fiord flowers early (75 to 85 days after sowing) and sets many pods from these first flowers. Unlike many other crops, faba bean tolerates mild frosts, being able to flower and set pods in winter and early spring. Consequently, when faba bean is sown early, growth of the seeds is largely completed before moisture stress starts in spring.

Part of the increasing success of faba bean in this State has been the release in 1992 of an improved rhizobial inoculum that fixes more nitrogen than the previous rhizobium and persists longer in soils with pH 5.0 to 6.0. It is now used also for field pea, lentil and vetch.

1 All soil measurements quoted are in 0.01 M calcium chloride.
A low cutting height is essential for lentil harvesting.

Diseases and varieties
Chocolate spot has been reported in most parts of the Western Australian wheatbelt, but disease pressure is low. While no ascochyta blight has been detected in the northern wheatbelt, it is the major fungal disease in cool southern areas. In general, these fungal diseases are less likely to be a problem in this State than in eastern Australia, because our winters are less humid. Nevertheless, disease resistant varieties and disease management practices will be needed in wet years.

Ascot, a new variety selected from Fiord, is resistant to ascochyta; otherwise it is similar to Fiord. Overall, Ascot has produced similar or slightly less yield than Fiord. However, the level of seed infection from ascochyta was much less than Fiord – low enough to meet human consumption standards. The cost of disease management will be reduced considerably with the release of Ascot to farmers; it will be widely available in 1996.

The variety Icarus is resistant to chocolate spot, but it flowers too late for our environments and yields considerably less than Fiord. Efforts are being made to combine resistances to both diseases in one variety. Early flowering lines with improved drought tolerance are also being evaluated.

Field pea
Field pea can produce high seed yields, especially in dry conditions. It can be sown late if necessary, because it has rapid seedling growth, early flowering and early maturity.

In trials comparing pulse crops throughout the State, Dundale field pea produced the highest yield in dry years. For example, it produced an average yield of 1.3 and 1.6 tonnes per hectare in 1991 and 1994 respectively.

The crop is best suited to well-drained fine-textured soils with a pH of 4.5 to 8.0. It has similar susceptibilities to waterlogging and frost as chickpea.

The fungal disease black spot can reduce yields when crops are sown immediately after the break of the season and in wet years. However, management practices such as delayed sowing and crop rotation can minimise disease infection.

Recent developments in management practices have largely overcome many of the problems faced by growers in the mid 1980s; there are growers in the State who have been producing field peas profitably for more than a decade.

A field pea breeding program was established in 1988 by Dr Tamveer Khan. Many advanced breeding lines within the program are yielding 20 to 30 per cent above Dundale. The South Australian variety Laura will be available to growers in 1996 for low to medium rainfall regions.

Lentil
Lentil is a high value crop and is one of the most drought tolerant pulse crops. Red lentils have small seeds with a reddish-purple coat and orange-red cotyledons. Green lentils have large seeds with a pale green coat and light brown cotyledons.

Lentil grows well on well-drained, alkaline clays and loams (pH 6.0 to 9.0). They do not tolerate soils with pH less than 6.0 and coarse textured soils (sands or sandy loams). Evaluation of the varieties Laird and Callisto in the 1980s showed that they produced considerable biomass but did not convert this growth into seed, because they flowered too late.

Recent studies with a limited range of lentil lines from the International Centre for Agriculture Research in Dry Areas (ICARDA), Syria showed that lines that flowered earlier than Laird or Callisto can produce yields of up to 1.0 tonne per hectare. Some of the superior lines were released in Victoria and South Australia in 1994-95 - Digger, Cobber, Matilda, Aldinga and Northfield. Because of the high prices for lentil ($400 to 600 per tonne), low yields can still generate reasonable gross margins.

The new lentil varieties released in the eastern States are still too late for short seasons. More than 250 lentil lines selected for early flowering were introduced from ICARDA, Bangladesh and Pakistan by CLIMA and evaluated in single rows or small plots at Merredin in 1994, a dry year. Of these lines, 41 red and green lentil lines produced yields that exceeded the control (Digger) by 10 to 98 per cent.

In 1994, 14 commercial growers grew Digger, Cobber and Matilda for the first time in Western Australia. Crops over an area of...
Yields of new chickpea lines in 1994

<table>
<thead>
<tr>
<th>Line</th>
<th>Yield (t/ha)</th>
<th>Average yield, as % of Tyson</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muresk</td>
<td>0.95</td>
<td>76</td>
</tr>
<tr>
<td>Merredin</td>
<td>0.76</td>
<td>100</td>
</tr>
<tr>
<td>Tyson</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>CTS60543</td>
<td>1.09</td>
<td>86</td>
</tr>
<tr>
<td>ICC4880</td>
<td>1.26</td>
<td>97</td>
</tr>
<tr>
<td>ICC88202</td>
<td>1.24</td>
<td>99</td>
</tr>
<tr>
<td>ICC88201</td>
<td>1.11</td>
<td>96</td>
</tr>
</tbody>
</table>

250 ha produced an average yield of 0.8 tonnes per hectare. Paddock selection, weed control and harvesting proved to be critical for profitable yields. We see lentil as a niche crop in Western Australia because of its particular soil requirements and because its short stature and tendency to lodge make harvesting difficult.

**Albus lupin**

The European white lupin or albus lupin is suited to well-structured, fine textured soils with an acid to neutral pH (4.5 to 7.5). The standard variety Kiev Mutant has large seeds and is best suited to areas with greater than 400 mm rainfall, a mild spring and deep soils. It is sensitive to transient waterlogging and does not tolerate free lime in the soil.

Kiev Mutant has greater resistance to cucumber mosaic virus than most narrow-leaved lupins, but is more susceptible to the fungal disease brown leaf spot.

Production of albus lupin in Western Australia has only increased significantly over the last two years, most being sold for human consumption in Egypt. Since this market is almost satisfied by the current production, they must be accepted into stockfeed markets before any further expansion in production can take place.

Dr Bevan Buichell runs an albus breeding program for better adaptation and yield through improved pod set, tolerance of high pH and lime, and greater resistance to brown leaf spot. The program also seeks greater adaptation to low rainfall areas through selecting for small seed.

**Potential production**

Our recent analysis of soil types, likely gross margins and rotations within the next decade shows the potential for more than 700,000 hectares of pulses in this State – 250,000 hectares of desi chickpea, 200,000 of faba bean, 100,000 hectares each of field pea and albus lupin and 10,000 hectares each of kabuli chickpea and lentil. This is an ambitious target. However, the current total production is about 140,000 hectares, similar to the area of lupins in 1980. We are optimistic about the future of the pulse industries and believe it is an achievable goal.

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**Further reading**


‘Agriculture Western Australia Farmnotes’


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