# New ascochyta blight resistant, high quality kabuli chickpea varieties for Australia

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## Abstract

In recent years, ascochyta blight has caused widespread yield losses in chickpea in Australia. The Australian chickpea industry is largely based on desi chickpeas. However there is the potential to increase the area of production of kabuli chickpea up to 200,000?ha in Australia with the availability of disease resistant varieties. Kabuli chickpea crossbred lines and commercial varieties from ICARDA (Syria), AARI (Turkey) and Australia were screened for resistance to ascochyta blight and agronomic traits in Turkey during 1998 and 2001. More than 2000 breeding lines were screened and 335 superior lines were selected and introduced to Australia. Further agronomic and seed quality evaluation, disease screening and seed production were undertaken in Australia to fast track one or more of the, superior ascochyta resistant kabuli chickpea lines for release. It is anticipated that the first variety from this project will be commercially released in 2004-05.

## Media summary

The development of kabuli chickpea varieties with ascochyta resistance, improved seed yield and large seed size will provide greater confidence and a profitable pulse option for Australian grain growers.

## Key words

Chickpea, ascochyta blight, kabuli, screening, breeding, international collaboration

## Introduction

Ascochyta blight, caused by *Ascochyta rabiei*, is the most damaging disease of chickpea in most parts of the world, and has caused widespread yield losses in Australia (Knights and Siddique 2002). The future of the Australian chickpea industry hinges on the development of varieties with high levels of resistance to ascochyta blight. In Australia both desi and kabuli chickpeas are grown commercially. There is the potential to increase the area of production of kabuli chickpea up to 200,000?ha in Australia with the availability of disease resistant varieties. In this study we developed strong international collaboration in order to fast track the release of new improved chickpea varieties with ascochyta blight resistance for Australia. The major aims were to utilise improved germplasm from the world's major kabuli chickpea improvement programs to select crossbred lines likely to be well adapted to Australian conditions, introduce promising crossbred lines to Australia and fast track new varieties with ascochyta blight resistance, improved seed yield and quality.

## Methods

### *Off-shore screening and selection*

Kabuli chickpea crossbred lines and commercial varieties from Syria, Turkey and Australia were screened for resistance to ascochyta blight at the Aegean Agricultural Research Institute (AARI) field site in Menemen, Izmir (Turkey) during 1998 and 2001. The disease nurseries in Turkey contained more than 2000 breeding lines from the International Centre for Agricultural Research in the Dry Areas (ICARDA), Syria and AARI, Turkey, and standard varieties from Syria, Turkey and Australia. The breeding lines and varieties were screened for resistance to ascochyta blight and suitable agronomic characteristics (e.g.

phenology, plant morphology, seed size and colour) and 335 lines with an ascochyta blight score less than 5 (0-9 scale, where 0 = no disease to 9 = dead) were selected and introduced to Australia.

*Screening for ascochyta blight resistance*

Chickpea crossbred lines were initially screened for ascochyta blight in South Australia (SA), Victoria, and New South Wales (NSW) where the disease had established by 1998. Disease screening continued at interstate location in 1999 and 2000, and at Medina (WA) in 2002 and 2003, and Dongara (WA) in 2003 after the disease had spread through the Western Region.

*Yield and agronomy*

The initial quantity of seed introduced to Australia was less than 50 seeds of each crossbred line (initially grown in the quarantine glasshouse), therefore evaluation was limited to agronomic adaptation in small field plots in WA (Bindoon). Further evaluation has been more extensive, expanding from one field scale replicated trial in 2002 at Dongara (WA) to eight sites across southern Australia in 2003 (Figure 1). Yield evaluation included crossbred lines, Kaniva, and three lines commercialised in Victoria/New South Wales in 2002 (FLIP94-90C FLIP94-92C and S95342). Foliar fungicides were applied twice (first at four weeks after emergence and second at podding) at each site in WA and eight times at Tamworth. No fungicide was applied at Dongara in 2002 or at Wagga Wagga, Horsham or Kingsford in 2003.

*Seed quality*

Mean seed weight, seed colour and seed size distribution of all promising crossbred lines was measured.

*Seed production*

Seed production of the most promising crossbred lines commenced by selecting single plants from plots at Bindoon between 1999 and 2001. Further bulk-up of the best crossbreds continued in WA under irrigation at Carnarvon during 2001, 2002 and 2003, and at Deepdale (near Geraldton) in 2003 (Figure 1).


**Figure 1. Locations of disease and yield evaluation trials ( ● ) and seed production sites ( ■) for kabuli chickpea crossbred lines**

## Results

*Screening for ascochyta blight resistance*

Disease ratings of kabuli chickpea crossbreds to ascochyta blight in Turkey were less than five for many crossbred lines (Figure 2). In general, the standard varieties were very susceptible to ascochyta blight and at flowering there were no surviving plants of the Australian varieties Kaniva and Bumper. Similar results have been reproduced in Australian disease nurseries and indicate that the resistance demonstrated in Turkey has been maintained under Australian growing conditions. The information generated from these nurseries in Turkey and Australia is being used to assist in the selection of the best adapted crossbred lines for release in 2004-05.

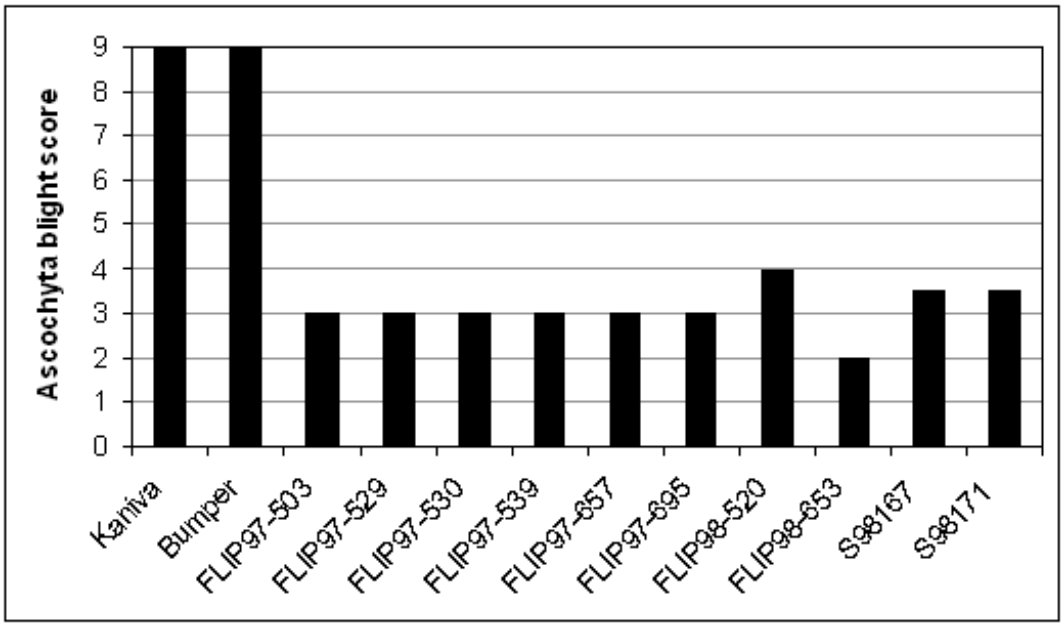


**Figure 2. Disease reaction of kabuli chickpea crossbred lines and standard varieties (Kaniva and Bumper) to ascochyta blight infection (where 0 = no disease to 9 = dead) measured at flowering in Menemen, Turkey 1998 to 2000**

*Yield and seed quality*

Mean seed yields in 2003 ranged from 650 kg/ha at Mingenew to 2224 kg/ha at Tamworth (data not presented). On average across sites in 2003, many crossbred lines produced more than 10% greater yield than Kaniva and also produced heavier seeds (Figure 3.). Average mean seed weights ranged from 27.0 g/100 seeds at Wagga Wagga to 40.5 g/100 seeds at Tamworth (data not presented). Of the crossbred lines, FLIP97-530-CLIMAS and S98167-CLIMAS produced the greatest seed yields on average across sites and had mean seed weights 15-21% greater than Kaniva. Based on the results from the trial at Dongara in 2002, many crossbred lines produce heavier seeds with a larger proportion of seeds greater than 8 and 9 mm in diameter compared to Kaniva, FLIP94-90C, FLIP94-92C and S95342 (Table 1). The Victorian/New South Wales releases yielded well, but generally produced seed with a larger proportion of small seeds (< 8 mm diameter) and lower mean seed weight.

*Seed production*

Seed production has been undertaken in conjunction with yield, disease and quality evaluation in an effort to reduce the time to release a new variety form this project. Production of basic seed of the three most

promising crossbred lines is being undertaken by the Council of Grain Growers Organisation (COGGO) growers in WA and a commercial partner in eastern Australia during 2004.

**Conclusion**

The off-shore screening site at Menemen in Turkey, where ascochyta blight is endemic, proved a reliable and less expensive way to screen for resistance at a time when the disease was not well-established across southern Australia. The international collaboration with ICARDA and AARI also helped screen such a large number of chickpea lines at this site. Selection and seed production carried out concurrently with agronomic and disease evaluation will allow the release of the first improved ascochyta blight resistant kabuli chickpea variety from this project by the end of 2004. Seed of the new variety will be available to growers for the 2005 growing season.

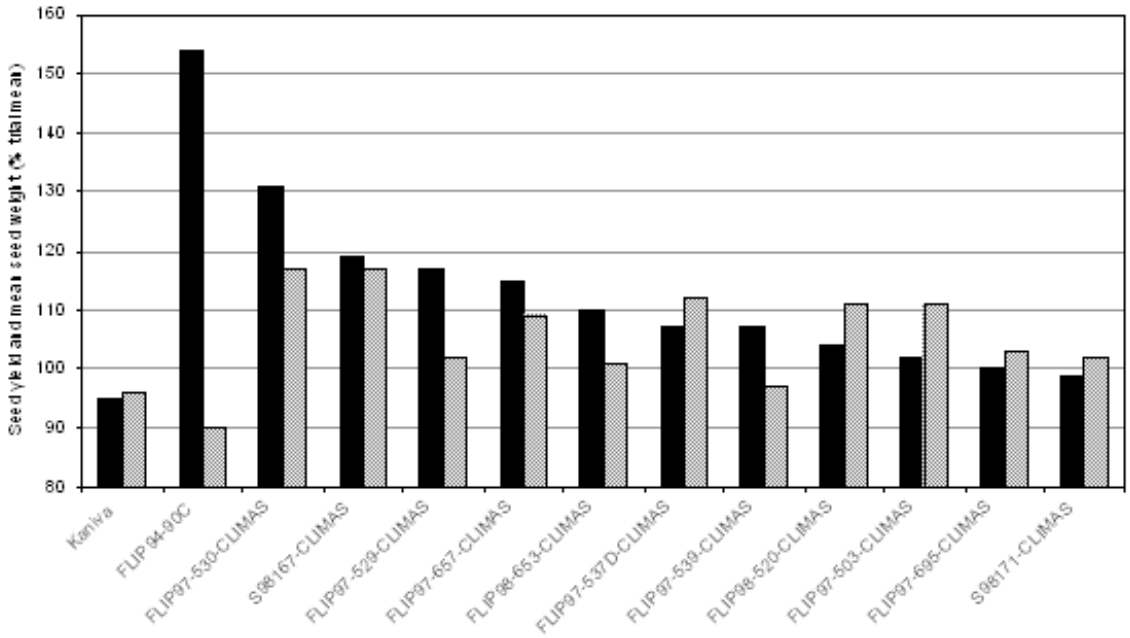


**Figure 3.Average seed yield ( ■) and mean seed weight ( ▨) (% trial mean) of crossbred lines and Kaniva across eight sites in Australia 2003 (-CLIMAS indicates selection from original breeding line)**

**Table 1. Mean seed weight (msw), and seed size distribution of ascochyta resistant kabuli chickpea crossbred lines at Dongara, 2002**

| Variety/ | msw | msw | Proportion of seed (%) | | | |
|---|---|---|---|---|---|---|
| crossbred | (g) | % Kaniva | >9mm | 8-9mm | 7-8mm | <7mm |
| Kaniva | 0.38 | 100 | 35 | 51 | 12 | 2 |
| Flip94-90C | 0.31 | 82 | 9 | 45 | 43 | 3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Flip94-92C | 0.36 | 95 | 29 | 55 | 14 | 2 |
| S95342 | 0.38 | 100 | 26 | 50 | 21 | 2 |
| Flip97-503-CLIMAS | 0.45 | 118 | 69 | 28 | 2 | 0 |
| Flip97-537D-CLIMAS | 0.45 | 118 | 62 | 34 | 4 | 0 |
| Flip97-657-CLIMAS | 0.42 | 111 | 49 | 43 | 7 | 1 |
| Flip97-530-CLIMAS | 0.41 | 108 | 48 | 45 | 6 | 1 |
| Flip97-529-CLIMAS | 0.40 | 105 | 47 | 42 | 10 | 1 |
| LSD (5%) | 0.01 | | 5 | 4 | 3 | 0.4 |

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