# New Varieties, New Agronomy - Pulse Agronomic Research, South-Eastern Australia

# 2009 Results Summary

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Please Note:
In all milestones, as a minimum we have provided a results table or summary, plus interpretation. In some instances, were data have been prepared for other industry reports, a more detailed report has been provided. Further information (including detailed methods) can be provided upon request.
*Data from this report is only to be used with authors' permission.*

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Ian Menz, II NSW

**RESEARCH HIGHLIGHTS**
In 2009, the Southern Pulse Agronomy research team conducted several trials to understand genotype by management interactions across south eastern Australia. The Victorian component of the project continues to focus on no-till cropping practices in line with the G x M research, with both sites sown inter-row into standing cereal stubble. In South Australia there was a strong focus on weed management in pulses, in particular, understanding the ability of chickpeas to compete with ryegrass and the optimum maturity timing of pulse varieties to crop topping. In addition, the variety specific agronomic management research continued on several exciting new varieties that are due for release from Pulse Breeding Australia (PBA). In 2009, we saw the release of two lentils PBAFlash and PBABounty and one Chickpea, PBASlasher in which the agronomy program provide vital management information and field day sites for open discussion of pulse issues.

**Genotype x management (GxM)**

- ROW SPACE/INTER-ROW SOWING, LENTILS AND CHICKPEAS: In Lentils, earlier sowing generally resulted in highest yield and best grain quality, particularly due to the extreme heatwave in November. There were no major differences in yield with wider row spacings (30cm c.f. 19.5cm), unlike 2007 and 2008, however standing stubble resulted in 20-100% increase in crop and pod height yield compared with slashed stubble treatments at Minyip, where biomass production was high. It was notable that the highest yielding variety at Minyip was PBAFlash which has slightly earlier maturity, combined with erect plant growth and high pod production. In chickpeas at Minyip, generally early sowing and higher plant densities resulted in highest yields. Wider row spacing's with standing stubble (60 and 30 cm) produced 10% higher grain yields than slashed stubble treatments (19.5 cm and 30 cm) for chickpeas in 2009.
- CROPTOPPING/DESICCATION: The dry and hot November in 2009 led to early senescence of pulse varieties and reduced grain yields in later maturing varieties. Many responses to the crop-topping treatments may have been masked by this rapid senescence eg Almaz and Genesis™114 chickpeas. Field peas and Faba beans generally showed no yield loss at the recommended timing for crop-topping of ryegrass in 2009. Lentils and chickpeas showed significantly higher yield losses from crop-topping, averaging 15 and 21% yield losses respectively at this timing. Early maturing lentil and chickpea lines showed yield losses from this practice at the recommended timing. This demonstrates the difficulty in employing this weed control technique in these crop types.
- WEED COMPETITION BY PLANT ARCHITECTURE, CHICKPEAS: Although chickpea yields were higher than previous years, the rapid finish to the season favoured earlier flowering and maturing varieties such as Genesis™079 and Sonali. Ryegrass competition at 31 and 86 plants/$m^2$ reduced chickpea grain yield by 31% and 56%, respectively. Similarly, at Turretfield ryegrass at 41 plants/$m^2$ corresponded to 33% yield loss, and 62% at 123 plants/$m^2$. Breeder's line "Chickpea 4" recorded the lowest yield loss from ryegrass competition at both sites (9% at the low ryegrass density at Hart), and also displayed 35% better tiller suppression than other varieties at Hart. Early vigour appeared an important trait in chickpea for improved competitiveness with ryegrass, whilst short plant height was a disadvantage, but further work is required on a larger set of phenotypes and in a more favourable growing season. Some ambiguous results in 2009 (eg PBA Slasher and Chickpea 2) may be due to the unfavourable seasonal conditions for chickpea production which prevailed in SA last year. However they do indicate the need for more work in a more favourable growing season, and potentially on a larger set of phenotypes (particularly those similar to Chickpea 4).
- BLACK SPOT, FIELD PEAS:-OZP0602 was generally higher yielding than Kaspa particularly in later sowing treatments. It was not as dependent as Kaspa on early sowing for maximum grain yield and therefore will provide an option for blackspot management in lower rainfall shorter growing season environments. Yield loss from blackspot can be minimised if peas are sown after 60% of airborne spores have been released. The combination of P-Pickel T with two

sprays of mancozeb was economic in the time of sowing trial at Hart in 2009, resulting in on average a 7-14% yield gain in Kaspa and OZP0602. Timing of foliar fungicide sprays relative to rainfall events and varietal flowering appears critical to yield response. Fortnightly sprays show more yield gains are possible, either through improved fungicides or increased genetic resistance.

**<u>Variety Specific Management</u>**

Information below outlines agronomic information for PBA varieties released for the 2010 cropping season.

**LENTILS**

**<u>PBA Flash$^A$</u>**

PBA Flash$^A$ is suited to all current lentil areas but particularly shorter-season areas where its high yield and earlier maturity improves reliability of yield, especially in lower yielding situations. It is also better suited than Nugget to early sowing dates and higher rainfall areas provided botrytis grey mould is managed.

Earlier maturity makes PBA Flash$^A$ the best variety for timely crop topping and it's well suited to no-till, inter-row sowing into standing residue. PBA Flash$^A$ is likely to be exported to medium red lentil markets, similar to Nugget.

*Key features*

- Highest yielding variety (average yield four to 10 per cent higher than Nugget across all lentil growing zones of Australia).
- Excellent yield in short season and low yielding environments.
- Early to mid maturity and more suited to crop topping.
- Erect growth habit and well suited to no-till, inter-row sowing on wider rows (30cm) into standing residue.
- Moderately resistant to seed and foliar ascochyta blight (AB).
- Susceptible to botrytis grey mould (BGM).
- Improved tolerance to soil boron and salinity compared to Nugget.
- Medium sized red lentil with lens seed shape and green seed coat.
- Improved milling quality.
- Herbicide tolerance similar to Nugget at label recommended rates of registered herbicides on calcareous alkaline soils.
- Can be more prone to yield loss at maturity than other varieties in windy environments due to improved standing ability at maturity. Timely harvest is critical in all lentil varieties.

**<u>PBA Bounty$^A$</u>**

PBA Bounty$^A$ is the highest yielding small round red lentil variety. PBA Bounty$^A$ is suited to all current lentil areas where it has consistently yielded about 5 per cent higher than Nugget. It can be grown in higher rainfall areas provided BGM is managed. PBA Bounty$^A$ is particularly suited to growers who can benefit from the higher prices that can exist for small red lentil without compromising yield compared to medium red lentils. PBA Bounty$^A$ is likely to be exported to small red lentil markets, similar to Nipper.

*Key features*

- Highest yielding small red lentil variety (average yield 2 to 6 per cent higher than Nugget across all lentil growing zones of Australia).
- Mid maturity similar to Nugget.
- Prostrate early growth habit.

- Moderately resistant to seed and foliar ascochyta blight (AB).
- Moderately susceptible to botrytis grey mould (BGM).
- Improved tolerance to salinity compared to Nugget.
- Small sized red lentil with round seed shape and grey seed coat.
- Increased sensitivity to high rates (twice label rate) of metribuzin compared with Nugget (similar to Nipper).
- Requires similar management to Nugget for maximum yields in southern Australia.

## CHICKPEAS

### PBA Slasher[A]

PBA Slasher[A] is the first release from the PBA chickpea program for southern Australia. PBA Slasher[A] has good yields across a wide range of environments and good ascochyta blight resistance. It has a semi-spreading plant type (similar to Howzat) with mid flowering and mid maturity. Seed size is larger and a more preferred colour than Genesis™509. In experimental testing, PBA Slasher[A] has had excellent milling quality.

*Key Features*

- Highest yielding desi chickpea with resistance to ascochyta blight in southern Australia. 10-15 per cent higher yielding than Genesis090.
- Requires fungicide applications during podding only for effective ascochyta blight control.
- Well suited to no-till, inter-row sowing on wider rows (30-60cm) into standing residue.
- Increased sensitivity to high rates (2x label rate) of flumetsulam on calcareous alkaline soils compared with Genesis 090, suggesting a narrow safety margin may apply to this herbicide.

## Trials conducted in 2009 on new pulse varieties across south-eastern.

| | Chickpeas | | | | | | | Faba beans | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Experiment** | **Genesis™ 090** | **Genesis™ 509** | **Almaz** | **CICA0503 (PBASlasherΦ)** | **CICA0512 (PBAHatrickΦ)** | **Genesis™ 114** | **Genesis™079** | **Farah** | **Nura** | **1269*483/6-1** | **974*(611*974)/15-1** |
| Sowing date | W, sM, NSW, cYP | W, sM, NSW cYP | W, sM | W, sM, NSW cYP | NSW | W, sM,cYP | W, sM, NSW cYP | W, NSW mN | W, NSW, mN | NSW, mN | W, NSW, mM |
| Plant density | W, NSW,cYP | W, NSW,cYP | W, NSW | W, NSW, cYP | NSW | W,cYP | W, NSW,cYP | W | W | | |
| Row spacing | W, sM, NSW | W, sM | W, sM | W, sM | NSW | W, sM | W,sM | W | W | | |
| Herbicide tolerance | W | | W | W | | W | W | | | | |
| Fungicide management | W | W | | | | W | W | mN | mN | mN | mN |
| Harvest timing | | | | | | | | | | | |
| **Wide scale release[2]** | 2005 | 2008 | 2007 | 2010 | 2010 | 2010 | 2010 | 2005 | 2006 | ?? | ?? |

| | Lentils | | | | | | | | Field peas | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Experiment** | **Nipper** | **Boomer** | **CIPAL411 (PBAFlashΦ)** | **CIPAL415 (PBABountyΦ)** | **CIPAL501** | **CIPAL610** | **CIPAL611** | **CIPAL702** | **OZP0601** | **OZP0602** | **OZP0703** | **OZP0705** | **Sturt** |
| Sowing date | W, sM cYP,nYP | W, sM cYP,nYP | W, sM cYP,nYP | W, sM | W, sM cYP,nYP ** | W, sM cYP,nYP ** | W, sM | | mN** | mN | mN** | | sM |
| Plant density | W, sM | W, sM | W, sM | W, sM | W, sM | W, sM | W, sM | | NSW | NSW | NSW | NSW | sM |
| Row spacing | W, sM | W, sM | W, sM | W, sM | W, sM | W, sM | W, sM | | NSW | NSW | NSW | NSW | sM |
| Herbicide tolerance | | | | | | | | | | | | | |
| Fungicide management | cYP,nYP | cYP, | cYP, | | cYP** | cYP** | cYP** | cYP** | mN | mN | mN | | |
| Harvest timing | | W,nYP | nYP | | nYP** | W, nYP** | nYP** | nYP** | | | | | |
| **Wide scale release[2]** | 2007 | 2007 | 20010 | 2010 | 2011 | 2011 | 2011 | 2011? | 2011 | 2011 | 2011 | ?? | ??? |

[1]W – Wimmera, Vic; sM – southern Mallee, Vic; mN – mid North, SA; nYP – northern Yorke Peninsula, SA; cYP – central Yorke Peninsula, SA; lEP – Lower Eyre Peninsula, SA; Wa – Wagga, NSW; Y, Yenda, NSW.

[2]Minimum of 400t of lentil seed and 750t of field pea and chickpea seed and 1000t of faba bean seed available to growers from commercialising company.

## GENOTYPE x MANAGEMENT EXPERIMENTS

1. Protocols outlined in attachment 1

# Milestone 2 – 30/3/09

Trials sown to determine optimum sowing dates, plant densities and row space for new kabuli and desi chickpea varieties as per Table above. New varieties will be compared with Genesis090 for at least 3 sowing dates, 4 plant densities and 2 row spacings. Establishment, flowering time, grain yield and seed quality attributes will be reported.

**TRIAL 1 and 2: Chickpea Sowing Time x Row Space x Plant Density, Wimmera (Horsham and Curyo), Victoria**

Please see genotype x management research in *milestone 14*. Trials 1.1 and 1.2.

**TRIAL 3: Chickpea Plant Density + Sowing Time + Row Space, Paskeville, Yorke Peninsula, SA**

### Aim

To maximise production advantages of new kabuli and desi chickpea varieties through the identification of optimum sowing dates and plant densities.

### Treatments

| | |
|---|---|
| Varieties: | Kabuli - Genesis079, Genesis090, Genesis114 |
| | Desi - Genesis509, PBASlasher |
| Sowing dates: | 7 May (Early), 27 May (Mid), 18 June (Late) |
| Plant densities: | 20, 35, 50 and 70 plants/m$^2$ |
| Fertiliser: | MAP + Zn @ 90kg/ha at sowing |

### Results and Interpretation

Yields at Paskeville in 2009 averaged 0.4t/ha higher than in 2008 across all sowing dates. As seen in lentils, there was an overall decrease in yield of all varieties as sowing was delayed (Figure 1). The early maturing Genesis079 was the highest yielding variety apart from a small number of treatments where it was the equal highest yielding variety along with Genesis509 or PBASlasher. No response to sowing density was observed in Genesis114 at any sowing date, or PBASlasher, Genesis090 and Genesis114 when sown early. Genesis079 and Genesis509 showed an increase in yield with increased sowing density, which became more apparent as sowing was delayed.

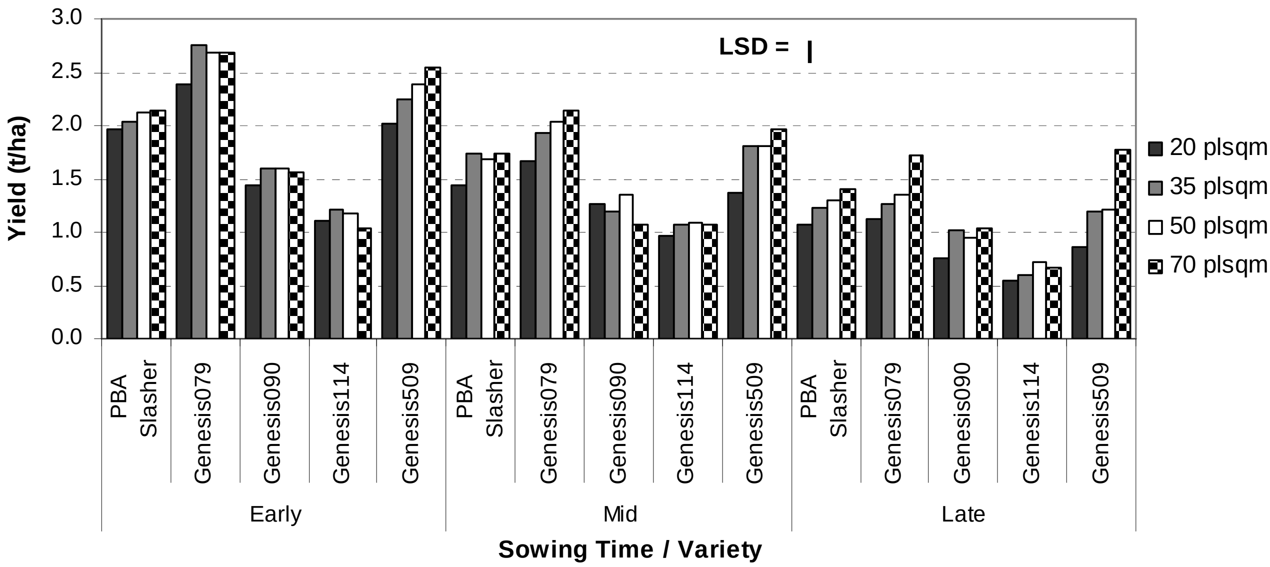


**Figure 1:** Effect of sowing date and density on yield of five chickpea varieties, Paskeville 2009.

**Table 1:** Effect of sowing date and plant density on grain weight at Paskeville 2009.

| Sowing date / Variety | Grain Weight (g/100 seeds) | | |
|---|---|---|---|
| | 7th May | 27th May | 18th June |
| **PBA Slasher** | 15.85 | 14.57 | 14.28 |
| **Genesis079** | 17.01 | 16.37 | 15.73 |
| **Genesis090** | 19.74 | 18.29 | 17.72 |
| **Genesis114** | 25.87 | 23.47 | 18.45 |
| **Genesis509** | 12.84 | 11.88 | 11.96 |
| **LSD (P>0.05)** | *1.22 (0.74 same TOS)* | | |

Grain weight was generally smaller in 2009 than 2008 with the kabuli varieties Genesis114 and Genesis090 reduced by up to 35% due to the heat wave event in early November. Grain weight was influenced by both sowing date and variety and was generally reduced as sowing date was delayed. The largest reduction occurred in Genesis114, while Genesis509 was the only variety not to incur a significant grain weight reduction as sowing date was delayed (Table 1).

## Key Findings and Comments

- Pod set in chickpeas was suppressed by the cool September and October in 2009. Dry spring conditions further suppressed grain yields and grain weights of late sown chickpea crops by terminating seed fill prematurely.
- The dry season favoured early sowing, and generally favoured the early maturing Genesis079. The desi's Genesis509 and new release PBASlasher generally performed similarly, although PBASlasher has higher long term yields and improved seed quality over Genesis509 in NVT trials.
- Earlier sown chickpeas yielded higher than those sown later. However, when sowing was delayed, yield was maximised in some varieties by increasing the seeding rate above recommended, similarly to 2008. However current chickpea densities of 35 plants/m$^2$ for kabuli's (small and large) and 50 plants/m$^2$ for desi's remain best-practice when sown early.
- Higher grain weights in chickpeas were achieved in 2009 by sowing early, particularly in larger seeded kabuli's. However this finding was opposite to that found in the past where later sowing dates have led to larger grain weights. Increasing plant density from current recommendations did not influence yield, but reducing density to 20 plants/m$^2$ did show a reduction in grain weight.

## Acknowledgments

The assistance of Mark Bennie, John Nairn, Peter Maynard and Rowan Steele, SARDI Clare, with trial management is gratefully acknowledged.

## TRIAL 4: Chickpea Row Space, Paskeville, Yorke Peninsula, SA

### Aim

To maximise production advantages of new kabuli and desi chickpea varieties through the identification of optimum sowing dates and plant densities.

### Treatments

Varieties: Kabuli - Genesis079, Genesis090, Genesis114
Desi - PBASlasher
Sowing date: 27 May
Row Spacing's: 22.5cm (9") and 45cm (18")
Fertiliser: MAP + Zn @ 90kg/ha at sowing

## Results and Interpretation

Increasing row spacing from 22.5cm (9”) to 45cm (18”) in chickpeas decreased yield, regardless of variety, resulting in an average 18% reduction in yield across all varieties tested in 2009 (Table 2). Variety ranking was the same for both row spacings.

A reduced and variable level of emergence in one row of the wide spacing treatments caused by compaction at sowing was noted and adjusted for in the analysis. There was no difference in grain weight between the two row spacings’, however there was a significant reduction in pod loss and lodging at the wider row spacing.

**Table 1:** The effect of row spacing on yield, pod loss and lodging of chickpeas, Paskeville 2009
Lodging score: 1 = flat, 9 = upright

| Row spacing | Yield (t/ha) | Pod Loss (#/m2) | Lodging (1-9 score) |
|---|---|---|---|
| **Narrow** | 1.68 | 10.9 | 7.5 |
| **Wide** | 1.37 | 5.1 | 7.9 |
| **LSD (P>0.05)** | *0.11* | *3.6* | *0.42* |

## Key Findings and Comments

- Doubling row spacing in chickpeas from 9” to 18” caused an 18% reduction in yield, although there were improvements in lodging and pod loss. Variety ranking was the same for both row spacings.
- Row spacing had no influence on grain weight in 2009.

## Acknowledgments

The assistance of Mark Bennie, John Nairn, Peter Maynard and Rowan Steele, SARDI Clare, with trial management is gratefully acknowledged.

## TRIAL 5: Chickpea Sowing Time, Wagga Wagga, NSW

***Aim:*** To test the yield response of six chickpea varieties to different sowing times and two targeted plant populations in southern NSW. The information from this trial will be used to improve current grower sowing time recommendations for chickpeas.

6 Chickpea varieties x 4 Time of sowing x 2 plant populations

| **Treatments** | | |
|---|---|---|
| Variety | Time of sowing | Targeted plant population |
| PBA Slasher | 4th May 2009 | $25/m^2$ |
| PBA Hatrick | 26th May 2009 | $40/m^2$ |
| Genesis509 | 19th June 2009 | |
| Genesis090 | 7th July 2009 | |
| Genesis079 | | |
| Genesis114 | | |

# Trial design

| | REP1 RANGE1 | | | | RANGE2 | | | | RANGE3 | | | | REP2 RANGE4 | | | | | RANGE5 | | | | RANGE6 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ROW | TRT | VAR | ST | SR | TRT | VAR | ST | SR | TRT | VAR | ST | SR | TRT | VAR | ST | SR | | TRT | VAR | ST | SR | TRT | VAR | ST |
| | 0 | | | | 14 | meters | | | 28 | | | | 52 | | | | | 66 | | | | 80 | | |
| Buffer | | Buffer | 2 | | | Buffer | 2 | | | Buffer | 2 | | | Buffer | 3 | | | | Buffer | 3 | | | Buffer | 3 |
| 1 | 29 | GEN090 | 2 | 40 | 22 | CICA512 | 2 | 25 | 25 | GEN079 | 2 | 25 | 37 | CICA503 | 3 | 25 | | 44 | GEN079 | 3 | 40 | 50 | GEN114 | 3 |
| 2 | 28 | GEN090 | 2 | 25 | 23 | CICA512 | 2 | 40 | 26 | GEN079 | 2 | 40 | 38 | CICA503 | 3 | 40 | | 43 | GEN079 | 3 | 25 | 49 | GEN114 | 3 |
| 3 | 19 | CICA503 | 2 | 25 | 31 | GEN114 | 2 | 25 | 35 | GEN509 | 2 | 40 | 40 | CICA512 | 3 | 25 | | 47 | GEN090 | 3 | 40 | 52 | GEN509 | 3 |
| 4 | 20 | CICA503 | 2 | 40 | 32 | GEN114 | 2 | 40 | 34 | GEN509 | 2 | 25 | 41 | CICA512 | 3 | 40 | | 46 | GEN090 | 3 | 25 | 53 | GEN509 | 3 |
| Buffer | | Buffer | 2 | | | Buffer | 2 | | | Buffer | 2 | | | Buffer | 3 | | | | Buffer | 3 | | | Buffer | 3 |
| Buffer | | Buffer | 1 | | | Buffer | 1 | | | Buffer | 1 | | | Buffer | 2 | | | | Buffer | 2 | | | Buffer | 2 |
| 5 | 2 | CICA503 | 1 | 40 | 8 | GEN079 | 1 | 40 | 4 | CICA512 | 1 | 25 | 32 | GEN114 | 2 | 40 | | 22 | CICA512 | 2 | 25 | 19 | CICA503 | 2 |
| 6 | 1 | CICA503 | 1 | 25 | 7 | GEN079 | 1 | 25 | 5 | CICA512 | 1 | 40 | 31 | GEN114 | 2 | 25 | | 23 | CICA512 | 2 | 40 | 20 | CICA503 | 2 |
| 7 | 11 | GEN090 | 1 | 40 | 14 | GEN114 | 1 | 40 | 17 | GEN509 | 1 | 40 | 28 | GEN090 | 2 | 25 | | 34 | GEN509 | 2 | 25 | 25 | GEN079 | 2 |
| 8 | 10 | GEN090 | 1 | 25 | 13 | GEN114 | 1 | 25 | 16 | GEN509 | 1 | 25 | 29 | GEN090 | 2 | 40 | | 35 | GEN509 | 2 | 40 | 26 | GEN079 | 2 |
| Buffer | | Buffer | 1 | | | Buffer | 1 | | | Buffer | 1 | | | Buffer | 2 | | | | Buffer | 2 | | | Buffer | 2 |
| Buffer | | Buffer | 3 | | | Buffer | 3 | | | Buffer | 3 | | | Buffer | 4 | | | | Buffer | 4 | | | Buffer | 4 |
| 9 | 52 | GEN509 | 3 | 25 | 40 | CICA512 | 3 | 25 | 44 | GEN079 | 3 | 40 | 59 | CICA512 | 4 | 40 | | 68 | GEN114 | 4 | 40 | 56 | CICA503 | 4 |
| 10 | 53 | GEN509 | 3 | 40 | 41 | CICA512 | 3 | 40 | 43 | GEN079 | 3 | 25 | 58 | CICA512 | 4 | 25 | | 67 | GEN114 | 4 | 25 | 55 | CICA503 | 4 |
| 11 | 46 | GEN090 | 3 | 25 | 50 | GEN114 | 3 | 40 | 37 | CICA503 | 3 | 25 | 70 | GEN509 | 4 | 25 | | 64 | GEN090 | 4 | 25 | 61 | GEN079 | 4 |
| 12 | 47 | GEN090 | 3 | 40 | 49 | GEN114 | 3 | 25 | 38 | CICA503 | 3 | 40 | 71 | GEN509 | 4 | 40 | | 65 | GEN090 | 4 | 40 | 62 | GEN079 | 4 |
| Buffer | | Buffer | 3 | | | Buffer | 3 | | | Buffer | 3 | | | Buffer | 4 | | | | Buffer | 4 | | | Buffer | 4 |
| Buffer | | Buffer | 4 | | | Buffer | 4 | | | Buffer | 4 | | | Buffer | 1 | | | | Buffer | 1 | | | Buffer | 1 |
| 13 | 61 | GEN079 | 4 | 25 | 56 | CICA503 | 4 | 40 | 65 | GEN090 | 4 | 40 | 2 | CICA503 | 1 | 40 | | 5 | CICA512 | 1 | 40 | 14 | GEN114 | 1 |
| 14 | 62 | GEN079 | 4 | 40 | 55 | CICA503 | 4 | 25 | 64 | GEN090 | 4 | 25 | 1 | CICA503 | 1 | 25 | | 4 | CICA512 | 1 | 25 | 13 | GEN114 | 1 |
| 15 | 68 | GEN114 | 4 | 40 | 70 | GEN509 | 4 | 25 | 59 | CICA512 | 4 | 40 | 17 | GEN509 | 1 | 40 | | 11 | GEN090 | 1 | 40 | 8 | GEN079 | 1 |
| 16 | 67 | GEN114 | 4 | 25 | 71 | GEN509 | 4 | 40 | 58 | CICA512 | 4 | 25 | 16 | GEN509 | 1 | 25 | | 10 | GEN090 | 1 | 25 | 7 | GEN079 | 1 |
| Buffer | | Buffer | 4 | | | Buffer | 4 | | | Buffer | 4 | | | Buffer | 1 | | | | Buffer | 1 | | | Buffer | 1 |

## Analysis

| Term | Df | denDF | F | Prob |
|---|---|---|---|---|
| VAR | 5 | 36 | 98.74 | <0.001 |
| ST | 3 | 5.9 | 74.81 | <0.001 |
| SR | 1 | 45.4 | 125.2 | <0.001 |
| VAR:ST | 15 | 35.8 | 2.765 | <0.01 |
| VAR:SR | 5 | 46.5 | 5.228 | <0.001 |
| ST:SR | 3 | 43.8 | 2.216 | n.s. |
| VAR:ST:SR | 15 | 42.7 | 1.817 | n.s. |

## Results

The full 3 way interaction was not significant, along with the interaction of sowing time and sowing rate. All the other interactions and main effects were highly significant.

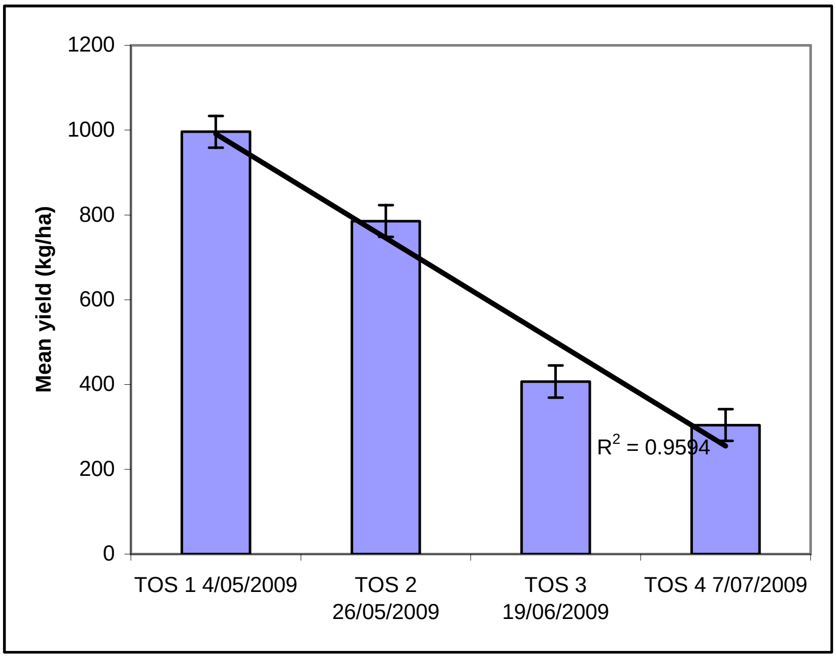


Table 1.1: The significant time of sowing effect of chickpeas, Wagga Wagga NSW 2009. Yields are means across all varieties for each time of sowing

As can be seen above (figure1.1), there was a highly significant time of sowing effect across all times of sowing with the each sowing time being significantly from each other. Yield wise May 4 > May 26 > June 19 > July 7. There was a 21% yield reduction between 4th May & 26th May sowing time, a massive 48% between 26th May & 19th June, and 25% between the final 2 sowing times.

The significant effects of time of sowing x variety can be seen in figure 1.2. Again the time of sowing effects can be clearly seen and across these also the varietal variation. All varieties displayed similarly trends with the exception of Genesis509, as it second sowing time was not significantly different from its first, suggesting it may have a wider sowing window. PBA Slasher, PBA Hatrick and Genesis509 had the highest yields at the last sowing date, albeit still very low yield levels, but supporting these varieties as the most suited to later plantings.

Regardless in this trial in a year like 2009 the results point out clearly that sowing beyond mid May results in rapidly declining grain yields

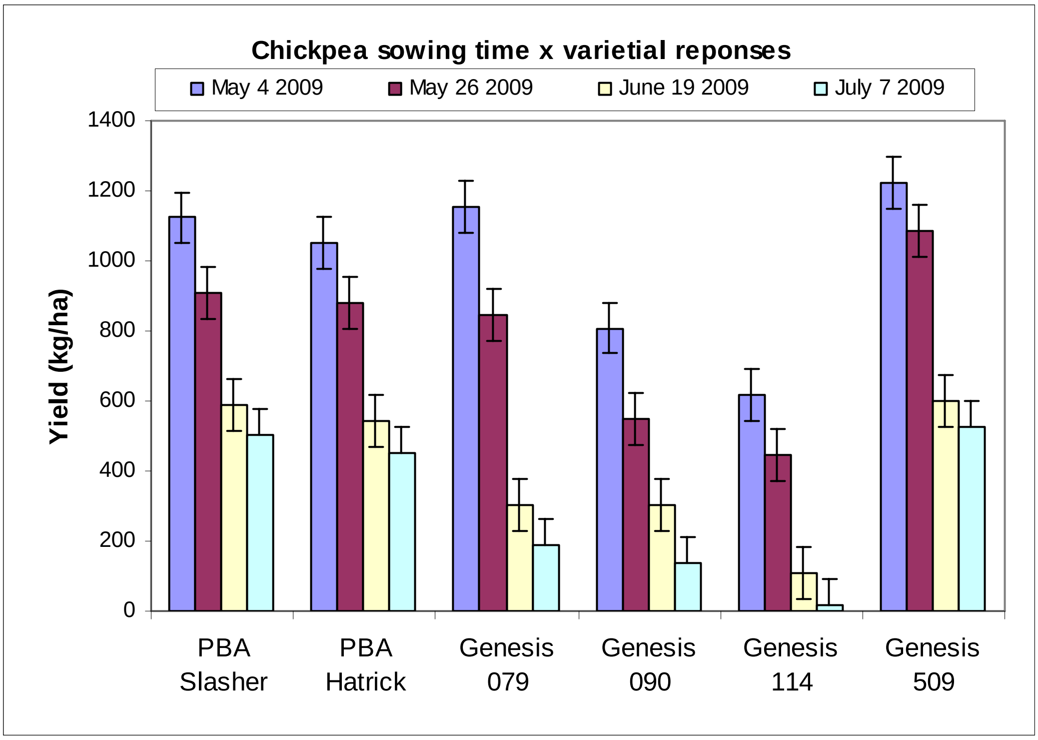


Figure 1.2: The effects of sowing time and variety averaged across plant populations on chickpea yields at Wagga Wagga NSW 2009.

The effect of plant population (figure1.3) was also found to be significant with higher yields achieved from the 40plant/m$^2$, out-yielding the 25plant/m$^2$ across all treatments with the exception of the two Kabuli lines Genesis 114 and Genesis 090, which showed no significant yield increase with increase plant population.

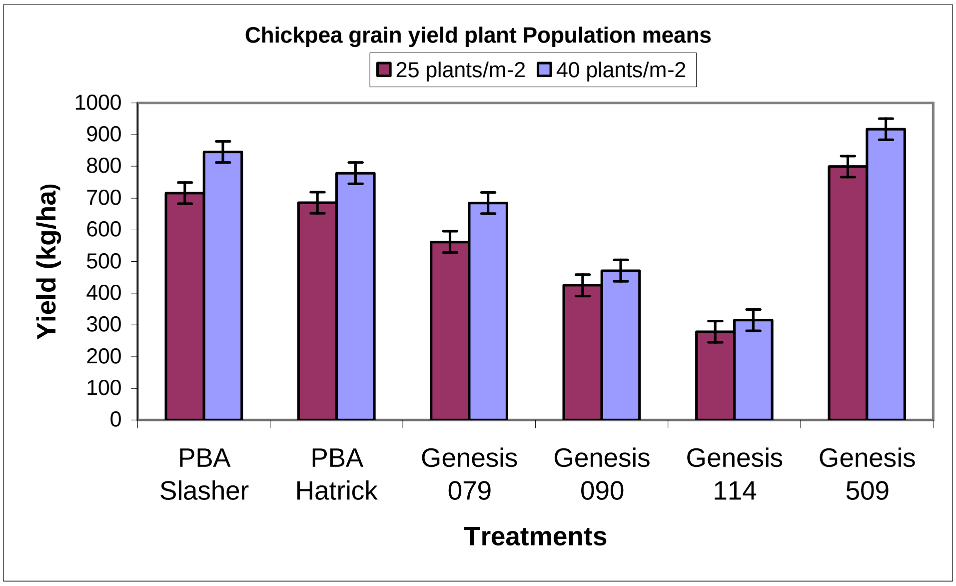


Figure 1.3: The effects of sowing time and plant population mean across all sowing dates on chickpea yields Wagga Wagga NSW 2009.

## TRIAL 6: Chickpea Sowing Time, Yenda, NSW

***Aim:*** To test the yield response of eight chickpea varieties to different sowing times in south western NSW. The information from this trial will be used to improve current grower sowing time recommendations for chickpeas.

8 Chickpea varieties x 3 times of sowing

| **Treatments** | | |
|---|---|---|
| Variety | Time of sowing | Targeted plant population |
| PBA Slasher | 13th May 2009 | $35/m^2$ |
| PBA Hatrick | 12th June 2009 | |
| Genesis509 | 3rd July 2009 | |
| Flipper | | |
| CICA0603 | | |
| Genesis079 | | |
| Genesis090 | | |
| Genesis114 | | |

## Trial design

| | REP1 | | | | | | REP2 | | | | | | REP3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RANGE1 | | | RANGE2 | | | RANGE3 | | | RANGE4 | | | RANGE5 | | | RANGE6 | | |
| ROW | TRT | VAR | ST | TRT | VAR | ST | TRT | VAR | ST | TRT | VAR | ST | TRT | VAR | ST | TRT | VAR | ST |
| Buffer | | Buffer | | | Buffer | | | Buffer | | | Buffer | | | Buffer | | | Buffer | |
| 1 | 8 | CICA0603 | 1 | 6 | GEN509 | 1 | 19 | GEN079 | 3 | 24 | CICA0603 | 3 | 15 | Flipper | 2 | 9 | PBA SLASHER | 2 |
| 2 | 1 | PBA SLASHER | 1 | 4 | GEN090 | 1 | 20 | GEN090 | 3 | 18 | PBA Hatrick | 3 | 13 | GEN114 | 2 | 11 | GEN079 | 2 |
| 3 | 3 | GEN079 | 1 | 5 | GEN114 | 1 | 23 | Flipper | 3 | 17 | PBA SLASHER | 3 | 14 | GEN509 | 2 | 16 | CICA0603 | 2 |
| 4 | 7 | Flipper | 1 | 2 | PBA Hatrick | 1 | 21 | GEN114 | 3 | 22 | GEN509 | 3 | 12 | GEN090 | 2 | 10 | PBA Hatrick | 2 |
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| 5 | 10 | PBA Hatrick | 2 | 13 | GEN114 | 2 | 3 | GEN079 | 1 | 6 | GEN509 | 1 | 17 | PBA SLASHER | 3 | 21 | GEN114 | 3 |
| 6 | 14 | GEN509 | 2 | 9 | PBA SLASHER | 2 | 2 | PBA Hatrick | 1 | 1 | PBA SLASHER | 1 | 19 | GEN079 | 3 | 18 | PBA Hatrick | 3 |
| 7 | 15 | Flipper | 2 | 16 | CICA0603 | 2 | 4 | GEN090 | 1 | 7 | Flipper | 1 | 23 | Flipper | 3 | 22 | GEN509 | 3 |
| 8 | 11 | GEN079 | 2 | 12 | GEN090 | 2 | 8 | CICA0603 | 1 | 5 | GEN114 | 1 | 24 | CICA0603 | 3 | 20 | GEN090 | 3 |
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| Buffer | | Buffer | | | Buffer | | | Buffer | | | Buffer | | | Buffer | | | Buffer | |
| 9 | 22 | GEN509 | 3 | 19 | GEN079 | 3 | 11 | GEN079 | 2 | 16 | CICA0603 | 2 | 1 | PBA SLASHER | 1 | 5 | GEN114 | 1 |
| 10 | 24 | CICA0603 | 3 | 21 | GEN114 | 3 | 14 | GEN509 | 2 | 13 | GEN114 | 2 | 7 | Flipper | 1 | 6 | GEN509 | 1 |
| 11 | 17 | PBA SLASHER | 3 | 20 | GEN090 | 3 | 10 | PBA Hatrick | 2 | 15 | Flipper | 2 | 8 | CICA0603 | 1 | 2 | PBA Hatrick | 1 |
| 12 | 18 | PBA Hatrick | 3 | 23 | Flipper | 3 | 9 | PBA SLASHER | 2 | 12 | GEN090 | 2 | 4 | GEN090 | 1 | 3 | GEN079 | 1 |
| Buffer | | Buffer | | | Buffer | | | Buffer | | | Buffer | | | Buffer | | | Buffer | |

## Analysis

| Term | Df | denDF | F | Prob |
|---|---|---|---|---|
| VAR | 7 | 23.6 | 33.01 | <0.001 |
| ST | 2 | 11.7 | 40.66 | <0.001 |
| VAR:ST | 14 | 22.1 | 4.16 | <0.01 |

The interaction of variety and sowing time was highly significant, as well as the main effects of variety and sowing time.

## Results

The varietal effects were strongly detected with the newly released PBA varieties proving their superiority over older chickpea varieties. Whilst there was a significant yield advance in sowing early, these overall yield levels were still relatively low across all treatments. This can be explained by the very poor finish to the season at Yenda compared to Wagga Wagga. However it can be clearly seen that the 13th May sowing time is equal to 12th June sowing time which are both greater then the final planting on the 3rd July (figure 1.4).

From this data in a year like 2009, a sowing of mid May may have not be early enough to optimise grain yield. However given a normal spring this mid May sowing may have been optimum. Therefore further testing in this environment is warranted especially with earlier sown treatment, potentially late April.

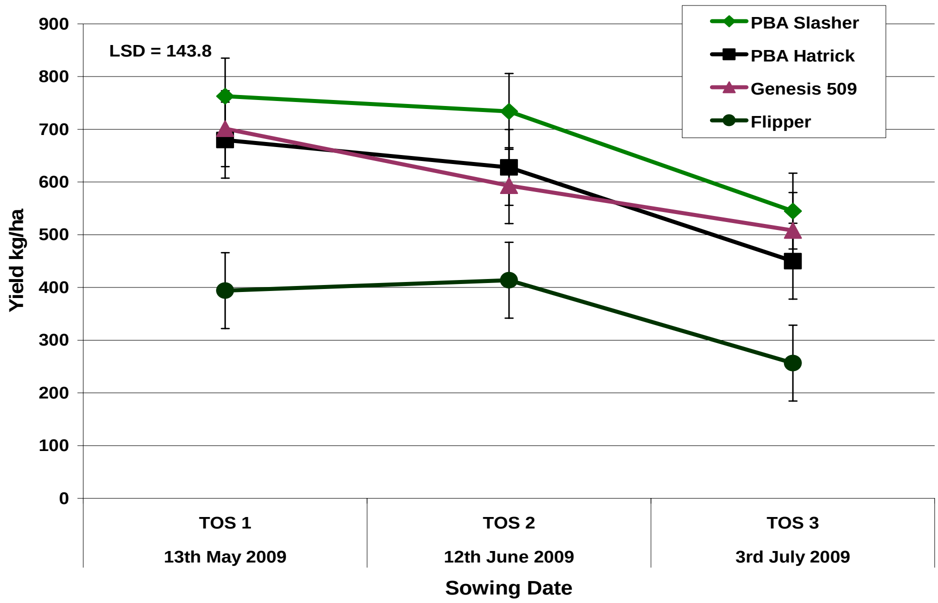


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Figure 1.4: The effects of sowing time and variety averaged on Desi chickpea yields at Yenda NSW 2009

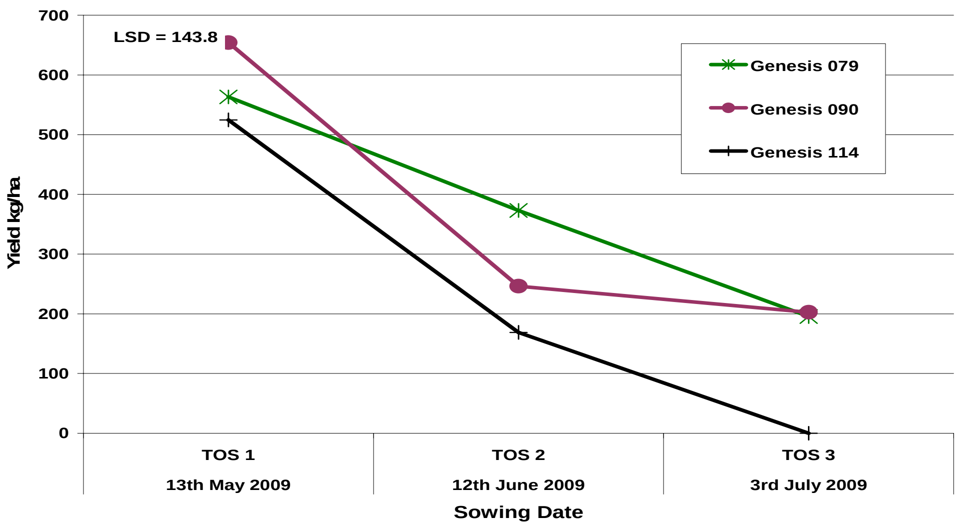


Figure 1.5: The effects of sowing time and variety on Kabuli chickpea yields at Yenda NSW 2009.

Genotype wise (figure 1.5), the Desi variety PBA Slasher bred specifically for southern chickpea regions had the overall highest mean yield across all sowing dates. It was significantly higher then PBA Hatrick and Flipper but equivalent to Genesis509 across all sowing dates.

Yield decline with Kabuli type chickpeas was more severe compared to Desi chickpeas. Kabuli varieties Genesis 079, 090 and 114 had a near linear yield decline with delayed planting. Again the harsh finish to the season may have contributed significantly to this outcome

## TRIAL 7: Chickpea Sowing Time, Cowra, NSW

***Aim:*** To test the yield response of eight chickpea varieties to different sowing times in south eastern NSW. The information from this trial will be used to improve current grower sowing time recommendations for chickpeas.

8 Chickpea varieties x 3 Time of sowings

| Treatments | | |
|---|---|---|
| Variety | Time of sowing | Targeted plant population |
| PBA Slasher | 7th May 2009 | 35/m2 |
| PBA Hatrick | 29th May 2009 | |
| Genesis509 | 18th June 2009 | |
| Flipper | | |
| CICA0603 | | |
| Genesis079 | | |
| Genesis090 | | |
| Genesis114 | | |

### Trial design

| ROW | REP1 RANGE1 TRT | Var | ST | RANGE2 TRT | Var | ST | REP2 RANGE3 TRT | Var | ST | RANGE4 TRT | Var | ST | REP3 RANGE5 TRT | Var | ST | RANGE6 TRT | Var | ST |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Buffer | | Buffer | | | Buffer | | | Buffer | | | Buffer | | | Buffer | | | Buffer | |
| 1 | 2 | CICA512 | 1 | 8 | CICA603 | 1 | 24 | CICA603 | 3 | 17 | CICA503 | 3 | 9 | CICA503 | 2 | 11 | GEN079 | 2 |
| 2 | 5 | GEN114 | 1 | 1 | CICA503 | 1 | 23 | FLIPPER | 3 | 21 | GEN114 | 3 | 10 | CICA512 | 2 | 13 | GEN114 | 2 |
| 3 | 7 | FLIPPER | 1 | 6 | GEN509 | 1 | 18 | CICA512 | 3 | 20 | GEN090 | 3 | 14 | GEN509 | 2 | 15 | FLIPPER | 2 |
| 4 | 4 | GEN090 | 1 | 3 | GEN079 | 1 | 19 | GEN079 | 3 | 22 | GEN509 | 3 | 12 | GEN090 | 2 | 16 | CICA603 | 2 |
| Buffer | | Buffer | | | Buffer | | | Buffer | | | Buffer | | | Buffer | | | Buffer | |
| Buffer | | Buffer | | | Buffer | | | Buffer | | | Buffer | | | Buffer | | | Buffer | |
| 5 | 14 | GEN509 | 2 | 9 | CICA503 | 2 | 6 | GEN509 | 1 | 4 | GEN090 | 1 | 18 | CICA512 | 3 | 22 | GEN509 | 3 |
| 6 | 11 | GEN079 | 2 | 12 | GEN090 | 2 | 8 | CICA603 | 1 | 5 | GEN114 | 1 | 17 | CICA503 | 3 | 23 | FLIPPER | 3 |
| 7 | 10 | CICA512 | 2 | 15 | FLIPPER | 2 | 7 | FLIPPER | 1 | 3 | GEN079 | 1 | 24 | CICA603 | 3 | 20 | GEN090 | 3 |
| 8 | 16 | CICA603 | 2 | 13 | GEN114 | 2 | 1 | CICA503 | 1 | 2 | CICA512 | 1 | 21 | GEN114 | 3 | 19 | GEN079 | 3 |
| Buffer | | Buffer | | | Buffer | | | Buffer | | | Buffer | | | Buffer | | | Buffer | |
| Buffer | | Buffer | | | Buffer | | | Buffer | | | Buffer | | | Buffer | | | Buffer | |
| 9 | 24 | CICA603 | 3 | 19 | GEN079 | 3 | 11 | GEN079 | 2 | 10 | CICA512 | 2 | 7 | FLIPPER | 1 | 2 | CICA512 | 1 |
| 10 | 22 | GEN509 | 3 | 17 | CICA503 | 3 | 15 | FLIPPER | 2 | 12 | GEN090 | 2 | 5 | GEN114 | 1 | 6 | GEN509 | 1 |
| 11 | 21 | GEN114 | 3 | 20 | GEN090 | 3 | 9 | CICA503 | 2 | 13 | GEN114 | 2 | 8 | CICA603 | 1 | 4 | GEN090 | 1 |
| 12 | 18 | CICA512 | 3 | 23 | FLIPPER | 3 | 16 | CICA603 | 2 | 14 | GEN509 | 2 | 3 | GEN079 | 1 | 1 | CICA503 | 1 |
| Buffer | | Buffer | | | Buffer | | | Buffer | | | Buffer | | | Buffer | | | Buffer | |

### Analysis

| Term | Df | denDF | F | Prob |
|---|---|---|---|---|
| VAR | 7 | 33.9 | 32.2 | <0.001 |
| ST | 2 | 21 | 144.5 | <0.001 |
| VAR:ST | 14 | 33.4 | 3.645 | <0.01 |

The interaction and the main effects of variety and sowing time were highly significant.

### Results

In figure 1.6, there is a clear significant effect of time of sowing, with a near linear yield decline with the delay in sowing. The grain yield decline after the 7th May planting was c. 25kg/day (mean across varieties).

There was also a significant varietal effect with the large seed size kabulis and older superseded variety (cv Flipper) having lower yields. Figure 1.7 shows high yields of 2.2 to 2.65t/ha for the first sowing time at Cowra. Genesis509 and PBA Slasher shows the greatest tolerance to delayed sowing as their yields decline on the 18th June sowing date was least compared to out varieties.

Overall from this trial, there was significant yield advantage achieved from varietal selection and from the sowing time of the crop. Flipper and kabuli types (Genesis114 & Genesis090) had significantly lower yields then all other varieties, in some cases significantly lower then the second sowing dates yields of the other higher yielding varieties (ie PBA Slasher, PBA Hatrick & Genesis509).

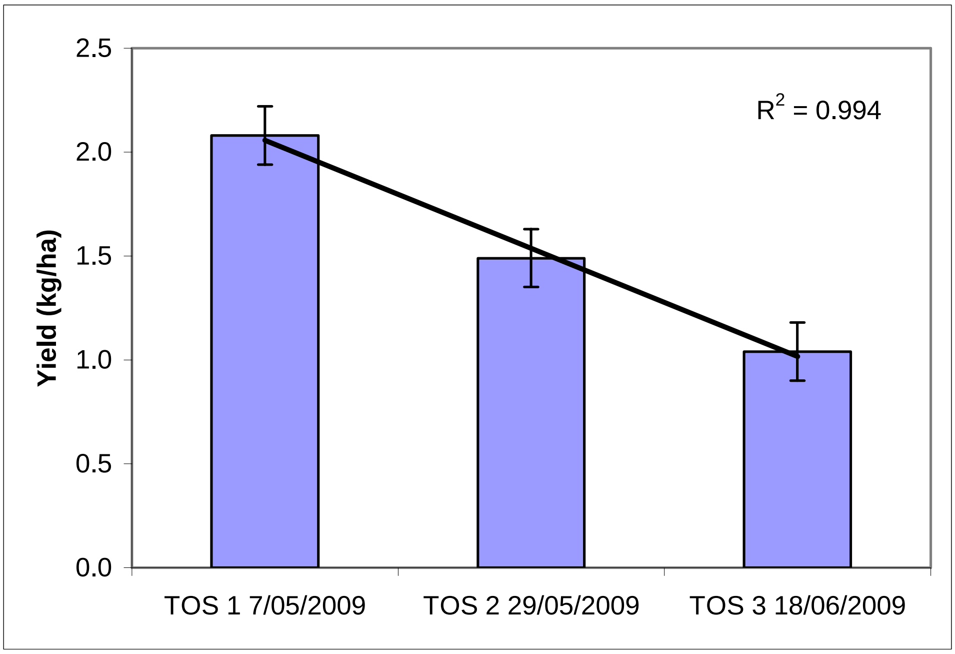


Figure 1.6: The grain yield of chickpeas over 3 sowing time in Cowra NSW 2009. Yields are means over 8 varieties.

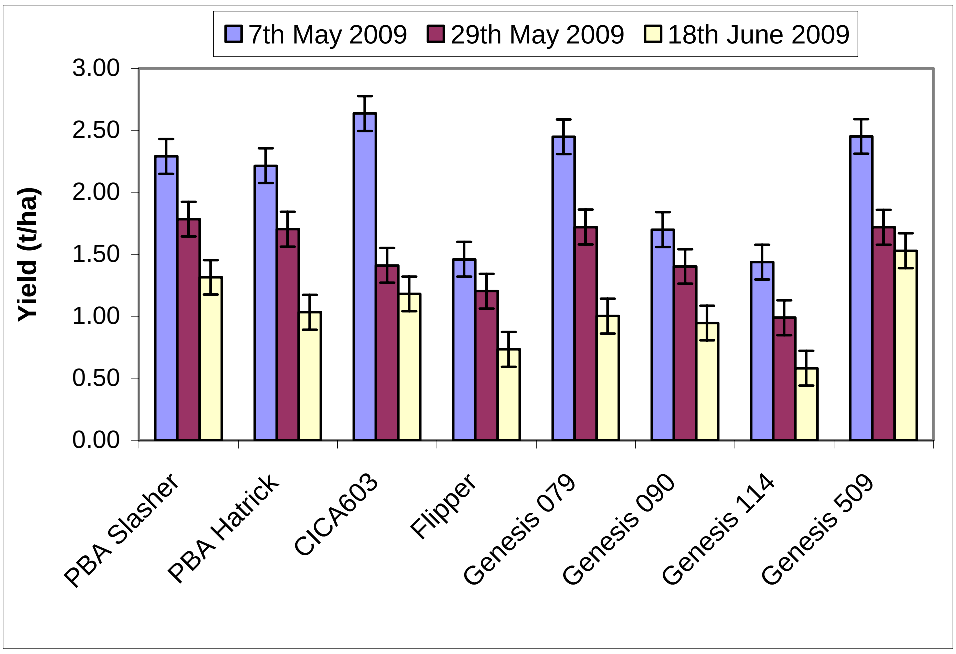


Figure 1.7: The mean grain yields of chickpeas sown over 3 sowing times in Cowra NSW 2009.

## TRIAL 8: Chickpea Plant Population, Yenda, NSW

***Aim:*** To test the yield response of new varieties and advanced lines of chickpeas to changes in plant populations in south western NSW. The information from this trial plus others is used to validate and improve grower recommendations.

8 Chickpea varieties x 5 targeted plant populations

| **Treatments** | | |
|---|---|---|
| Variety | Targeted plant population | Sowing date |
| PBA Slasher | $10/m^2$ | May 15th 2009 |
| PBA Hatrick | $25/m^2$ | |
| Genesis509 | $40/m^2$ | |
| CICA511 | $55/m^2$ | |
| CICA0603 | $70/m^2$ | |
| Genesis079 | | |
| Genesis090 | | |
| Genesis114 | | |

### Results

There were no significant varietal differences in either the curvature or linear response to plant density. There was however highly significant main effects of variety and plant density and an overall curvature effect.

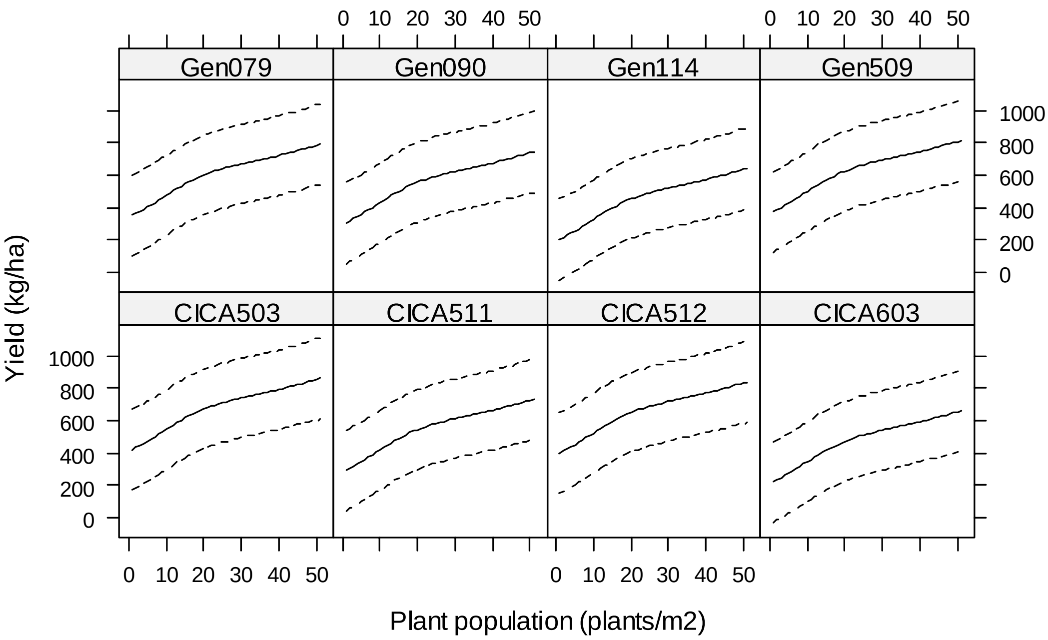


Figure 1.8. The variety x actual plant populations mean grain yield for chickpeas at Yenda NSW 2009. (note: PBA Slasher is CICA503 & PBA Hatrick is CICA512).

As can be seen in figure 1.8, each variety's behaviour to increasing plant population was not significantly different, that is as actual plant populations increased, grain yields also increased across all varieties. This rate or trend of yield increase was similar across all varieties.

However there was significant plant population effect on grain yields detected, with the higher populations resulting in significantly higher grain yields then the lower plant populations. In this trial, a population on between 30-50plants/$m^2$ resulted in the greatest yields and were not significantly different from each other. Actual plant populations of lower then 30 plants resulted in significantly detectable yield decline. Plant populations of or greater then 70plant/$m^2$ were not achieved in this trial, however it is suggested that yields would begin to plateau at this level.

There was a significant variety effect with some varieties having significantly higher grain yields levels then others (ie PBS Slasher & Genesis509 had higher mean yields then Genesis114 & CICA603).

## TRIAL 9: Chickpea Plant Population, Harden, NSW

***Aim:*** To test the yield response of new varieties and advanced lines of chickpeas to changes in plant populations in high rainfall area of south eastern NSW. The information from this trial plus others is used to validate and improve grower recommendations.

6 Chickpea varieties x 3 targeted plant populations

| **Treatments** | | |
|---|---|---|
| Variety | Targeted plant population | Sowing date |
| PBA Slasher | $24/m^2$ | June 30th 2009 |
| PBA Hatrick | $36/m^2$ | |
| Genesis509 | $48/m^2$ | |
| Genesis079 | | |
| Genesis090 | | |
| Genesis114 | | |

### Results

There was no significant variety by seeding rate interaction. There was however very significant main effects of variety (p<0.0001) and seeding rate (p<0.0001).

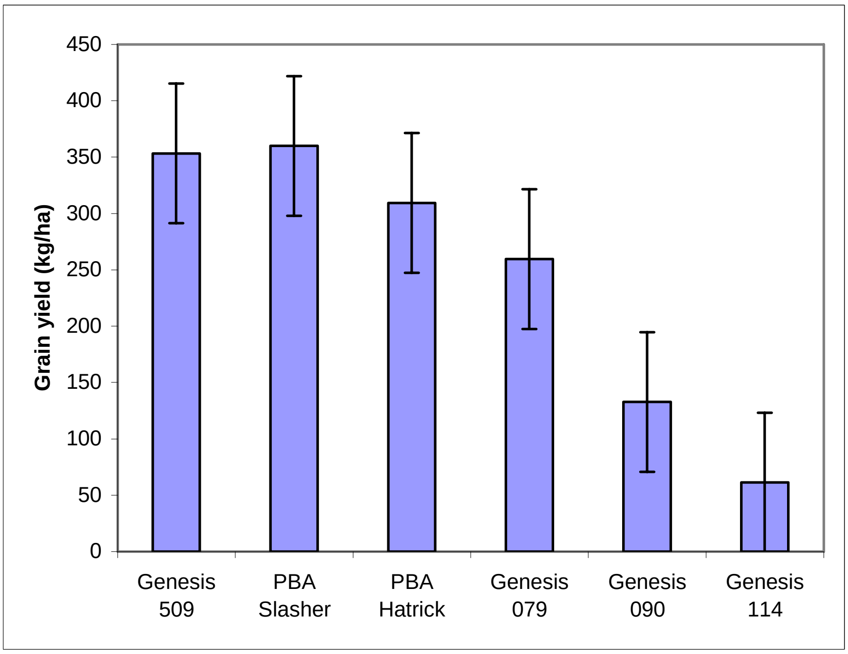


Figure 1.9. The mean grain yield for chickpeas varieties at Harden NSW 2009.Means are calculated across plant populations.

As can be seen in figure 1.9, there was a significant varietal difference detected. This showed the kabuli type varieties Genesis090 and Genesis114 to be significantly lower yielding then desi types Genesis509, PBA Slasher & Hatrick and small seeded kabuli type Genesis079.Whilst this yield level in relatively low, this variety outcome is similar to other trials conducted in 2008 and 2009. The low yield levels in this particular trial are contributed to site selection issues including increase insect pressure and control issues, huge weed seed bank & control issues and very poor spring finish. Needless to say further work is required in this area to strengthen and support the results under high yield situations.

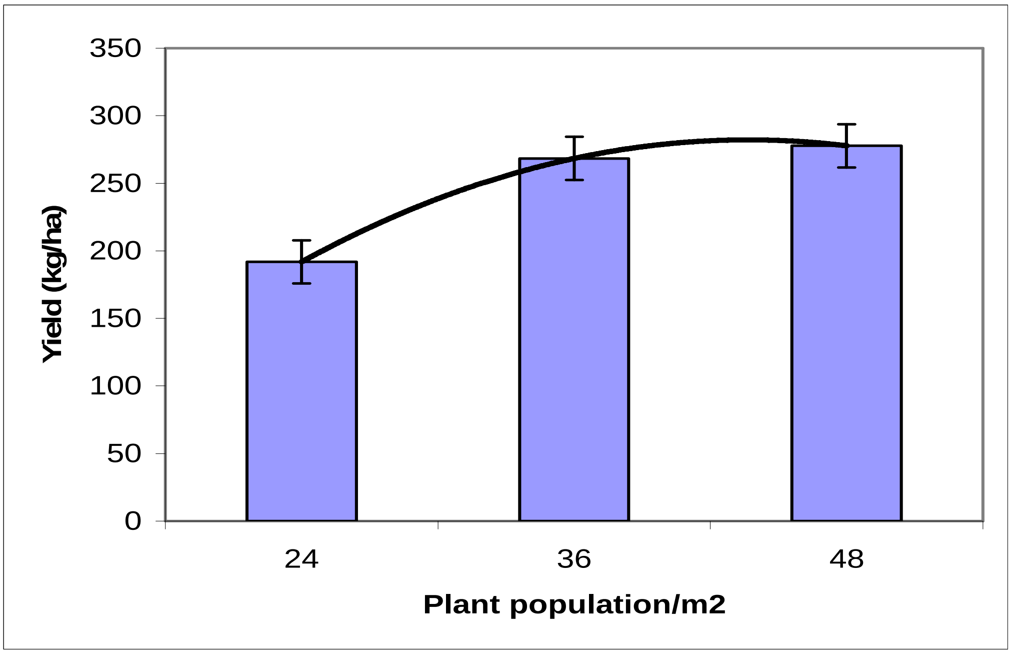


Figure 1.10. The plant population effect on mean grain yield for chickpeas at Harden NSW 2009.
Means are across all varieties).

Further analysis (figure 1.10) detected a yield decline with the lowest plant populations. This results correlates well with previous experience and other population trials in southern NSW. However further work could be conducted to understand the effects under a high yield situation.

## TRIAL 10: Chickpea Row Spacing, Yenda, NSW

***Aim:*** To investigate the effects of row spacing and plant populations across a range of advanced varieties on yields of chickpea at Yenda in south western NSW

5 Chickpea varieties x 2 targeted plant populations x 4 rows spacing configurations

| **Treatments** | | | |
|---|---|---|---|
| Variety | Row spacing | Targeted plant population | Sowing date |
| PBA Slasher | 20cm | 25 plant/m$^2$ | June 12$^{th}$ 2009 |
| Genesis509 | 30cm | 40 plant/m$^2$ | |
| Almaz | 40cm | | |
| Genesis114 | 50cm | | |
| Genesis090 | | | |

**Analysis**

| Term | Df | denDF | F | Prob |
|---|---|---|---|---|
| VAR | 4 | 34.7 | 305.4 | <0.001 |
| SPACE | 3 | 13.8 | 7.623 | <0.01 |
| POP | 1 | 42.4 | 28.02 | <0.001 |
| VAR:SPACE | 12 | 33.6 | 2.407 | <0.05 |
| VAR:POP | 2 | 41.7 | 1.311 | n.s. |
| SPACE:POP | 3 | 45.7 | 0.8443 | n.s. |
| VAR:SPACE:POP | 6 | 41 | 1.087 | n.s. |

There was a significant effect of variety, row spacing, plant population and variety x row spacing. The full 3-way interaction and the interactions of population by variety and row spacing were not significant.

### Results

Whilst there was significant effects and interaction detected in this trial, there was an underlying effect of metribuzin chemical damage across entire trial causing establishment issues. This occurred due to the site's characteristically sandy soils and very heavy high rainfall event immediately after sowing. This chemical damage was more pronounced in the kabuli type chickpeas albeit still damaging to the desi type varieties which was determined by plant counts and can be clearly seen by yield levels. The metribuzin was applied post-sowing pre-emergence which in hindsight likely increased the severity of damage to the trial because of the very heavy rainfall immediately after spraying.

The results (figure 1.11) still provide a valuable trend to yields across widening row spacings. Across desi type chickpea there was a very strong correlation of maximum yields achieved with row spacing between 30-40cm. Kabulis also displayed a very similar trend. Whilst these were relatively low yield levels, they correlate well with previous trials conducted over previous seasons, with 30cm being optimum row spacing. Again the very poor finish to the season finished crop prematurely and limited grain yields.

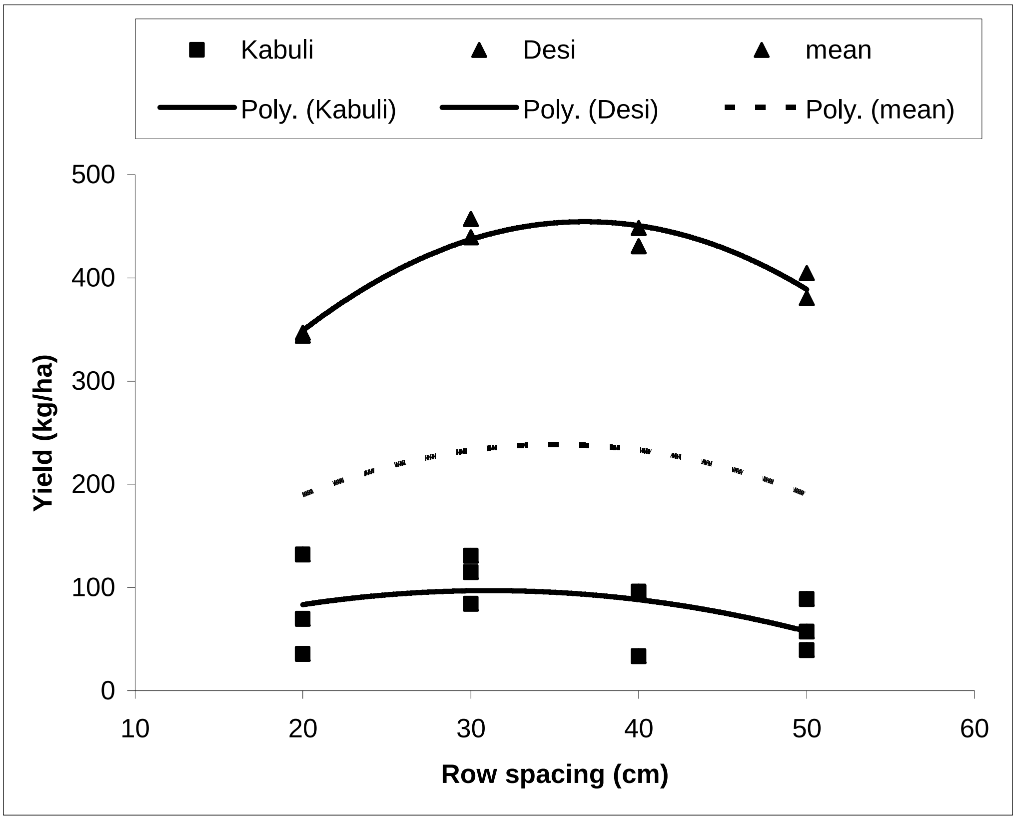


Figure 1.11: The effects of rowspacing on chickpea grain yields at Yenda, south western NSW. The means are across plant populations and varieties.

# Milestone 3 – 30/3/2009

Trials sown to determine optimum disease management strategy, focussing on podding applications, in new resistant and moderately resistant desi and kabuli chickpea varieties as per Table above. New varieties will be compared with Genesis090 for at least 3 disease management strategies. Flowering time, disease severity, grain yield and seed quality attributes will be reported.

**TRIAL 1: Chickpea Disease Management, Wimmera (Minyip), Victoria**

Treatments

- Varieties (Genesis090, Genesis079, Genesis114, Almaz, PBASlasher, CICA0603 and CICA0604)
- Treatments

Table 3.1. Fungicide treatments, rates and timings used at Minyip and Curyo to control ascochyta blight.

| Regime | Chemical & Application Rate[1] | Timing |
|---|---|---|
| Fortnightly | chlorothalonil 500 @ 2 L/ha | Fortnightly starting 6 weeks after emergence. |
| Strategically | chlorothalonil 500 @ 2 L/ha | Strategically from vegetatively through to podding |
| Podding | chlorothalonil 500 @ 2 L/ha | Podding |
| Nil | Nil | Nil |

1. Refers to application rate of the product

### Results and Interpretation

- Key Message: Significant levels of disease were present in the trial this year, but due to the high temperatures in November causing a short finish, it appears that potential yield differences were negated.
- Climate – see milestone 14
- Ascochyta Blight score – Significant infection of Ascochyta Blight occurred in 2009. Symptoms were worst on Almaz and least on Genesis090 (Table 3.2). The fortnightly application of fungicide resulted in very few symptoms for all lines compared, significantly less than other application regimes. Generally there was little difference in Ascochyta blight scores for all lines within each of the podding, fortnightly, strategic and nil application regimes (Table 3.2). For, CICA0603 and CICA0604, it appears that the scores were significantly less in the nil than podding and strategic regimes. The reason for these differences is unclear.
- Grain yield – Grain yields were generally highest in the fortnightly regime significantly greater than other spray regimes (Table 3.3). In this treatment, CICA0603 and CICA0604 had the highest yields and Almaz and Genesis114 lowest. Although no significant interaction between genotype and regime was noted, it appears that all genotypes except Genesis090 suffered a reduction in yield when no fungicide was applied (Table 3.3). Apparent yield reductions were also observed for the podding and strategic regimes. The data indicate that the new lines CICA0603 and CICA0604 may need an appropriate fungicide application package to ensure minimal yield loss.
- Seed Quality - There were no visual symptoms of ascochtya blight on seed.

Table 3.2. Ascochyta Blight scores (1 – no symptoms, 9 – complete plant death) of chickpea varieties in disease management trial at Minyip in 2009.

| Regime | Almaz | PBASlasher | Genesis 079 | Genesis 090 | Genesis 114 | CICA0603 | CICA0604 |
|---|---|---|---|---|---|---|---|
| **Fortnightly** | 2.3 | 1.5 | 1.5 | 1.3 | 1.8 | 1.3 | 1.3 |
| **Podding** | 6.8 | 2.8 | 3.5 | 2.0 | 3.0 | 2.8 | 3.0 |
| **Strategically** | 5.5 | 2.8 | 2.8 | 2.0 | 3.0 | 3.5 | 3.8 |
| **Nil** | 7.0 | 2.3 | 2.5 | 2.0 | 2.8 | 2.5 | 2.0 |

$lsd_{(regime x genotype)}$ - 0.8 (within regime = 0.7)

Table 3.3. Grain Yields of chickpea varieties in disease management trial at Minyip in 2009.

| Regime | Almaz | PBASlasher | Genesis 079 | Genesis 090 | Genesis 114 | CICA0603 | CICA0604 | *Average* |
|---|---|---|---|---|---|---|---|---|
| **Fortnightly** | 0.86 | 0.97 | 1.02 | 1.02 | 0.83 | 1.14 | 1.11 | *0.99* |
| **Podding** | 0.65 | 0.90 | 0.89 | 1.04 | 0.81 | 0.86 | 0.93 | *0.82* |
| **Strategically** | 0.57 | 0.88 | 0.96 | 0.92 | 0.64 | 0.89 | 0.88 | *0.87* |
| **Nil** | 0.62 | 0.92 | 0.94 | 1.07 | 0.74 | 0.90 | 0.95 | *0.88* |
| ***Average*** | *0.67* | *0.92* | *0.95* | *1.01* | *0.75* | *0.95* | *0.97* | |

$lsd_{(genotype)}$ - 0.08; $lsd_{(regime)}$ - 0.1

# Milestone 4 – 30/3/2009

Trials sown to determine plant densities and row space for new field pea varieties as per Table above. New varieties will be compared with Kaspa for at least 4 plant densities and 2 row spacings. Establishment, flowering time and grain yield will be reported.

## 1 Field Pea, Sowing Time, Wagga Wagga, NSW

***Aim:*** To test the yield response of six fieldpea varieties to different sowing times and two targeted plant populations in south western NSW. The information from this trial will be used to improve current grower sowing time recommendations for chickpeas.

8 fieldpea varieties x 3 Time of sowing x 2 plant populations

| **Treatments** | | |
|---|---|---|
| Variety | Time of sowing | Targeted plant population |
| Kaspa | 13th May 2009 | $30/m^2$ |
| Yarrum | 12th June 2009 | $50/m^2$ |
| OZP0703 | 3rd July 2009 | |
| OZP0601 | | |
| OZP0602 | | |
| OZP0901 | | |
| Sturt | | |
| Maki | | |

## Trial design

| | REP1 | | | | | | | | REP2 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RANGE1 | | | | RANGE2 | | | | RANGE3 | | | |
| ROW | TRT | VAR | SR | ST | TRT | VAR | SR | ST | TRT | VAR | SR | ST |
| Buffer | | Buffer | | | | Buffer | | | | Buffer | | |
| 1 | 15 | OZP0901 | 30 | 1 | 8 | YARRUM | 50 | 1 | 41 | STURT | 30 | 3 |
| 2 | 16 | OZP0901 | 50 | 1 | 7 | YARRUM | 30 | 1 | 42 | STURT | 50 | 3 |
| 3 | 1 | OZP0601 | 30 | 1 | 14 | OZP0703 | 50 | 1 | 43 | OZP0602 | 30 | 3 |
| 4 | 2 | OZP0601 | 50 | 1 | 13 | OZP0703 | 30 | 1 | 44 | OZP0602 | 50 | 3 |
| 5 | 9 | STURT | 30 | 1 | 6 | MAKI | 50 | 1 | 37 | MAKI | 30 | 3 |
| 6 | 10 | STURT | 50 | 1 | 5 | MAKI | 30 | 1 | 38 | MAKI | 50 | 3 |
| 7 | 3 | KASPA | 30 | 1 | 11 | OZP0602 | 30 | 1 | 36 | KASPA | 50 | 3 |
| 8 | 4 | KASPA | 50 | 1 | 12 | OZP0602 | 50 | 1 | 35 | KASPA | 30 | 3 |
| Buffer | | Buffer | | | | Buffer | | | | Buffer | | |
| Buffer | | Buffer | | | | Buffer | | | | Buffer | | |
| 9 | 41 | STURT | 30 | 3 | 45 | OZP0703 | 30 | 3 | 18 | OZP0601 | 50 | 2 |
| 10 | 42 | STURT | 50 | 3 | 46 | OZP0703 | 50 | 3 | 17 | OZP0601 | 30 | 2 |
| 11 | 38 | MAKI | 50 | 3 | 44 | OZP0602 | 50 | 3 | 24 | YARRUM | 50 | 2 |
| 12 | 37 | MAKI | 30 | 3 | 43 | OZP0602 | 30 | 3 | 23 | YARRUM | 30 | 2 |
| 13 | 40 | YARRUM | 50 | 3 | 36 | KASPA | 50 | 3 | 26 | STURT | 50 | 2 |
| 14 | 39 | YARRUM | 30 | 3 | 35 | KASPA | 30 | 3 | 25 | STURT | 30 | 2 |
| 15 | 48 | OZP0901 | 50 | 3 | 34 | OZP0601 | 50 | 3 | 32 | OZP0901 | 50 | 2 |
| 16 | 47 | OZP0901 | 30 | 3 | 33 | OZP0601 | 30 | 3 | 31 | OZP0901 | 30 | 2 |
| Buffer | | Buffer | | | | Buffer | | | | Buffer | | |
| Buffer | | Buffer | | | | Buffer | | | | Buffer | | |
| 17 | 26 | STURT | 50 | 2 | 24 | YARRUM | 50 | 2 | 2 | OZP0601 | 50 | 1 |
| 18 | 25 | STURT | 30 | 2 | 23 | YARRUM | 30 | 2 | 1 | OZP0601 | 30 | 1 |
| 19 | 20 | KASPA | 50 | 2 | 21 | MAKI | 30 | 2 | 12 | OZP0602 | 50 | 1 |
| 20 | 19 | KASPA | 30 | 2 | 22 | MAKI | 50 | 2 | 11 | OZP0602 | 30 | 1 |
| 21 | 29 | OZP0703 | 30 | 2 | 32 | OZP0901 | 50 | 2 | 7 | YARRUM | 30 | 1 |
| 22 | 30 | OZP0703 | 50 | 2 | 31 | OZP0901 | 30 | 2 | 8 | YARRUM | 50 | 1 |
| 23 | 17 | OZP0601 | 30 | 2 | 28 | OZP0602 | 50 | 2 | 6 | MAKI | 50 | 1 |
| 24 | 18 | OZP0601 | 50 | 2 | 27 | OZP0602 | 30 | 2 | 5 | MAKI | 30 | 1 |
| Buffer | | Buffer | | | | Buffer | | | | Buffer | | |

| | | | | | REP3 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RANGE4 | | | | RANGE5 | | | | RANGE6 | | | |
| ROW | TRT | VAR | SR | ST | TRT | VAR | SR | ST | TRT | VAR | SR | ST |
| Buffer | | Buffer | | | | Buffer | | | | Buffer | | |
| 1 | 34 | OZP0601 | 50 | 3 | 25 | STURT | 30 | 2 | 21 | MAKI | 30 | 2 |
| 2 | 33 | OZP0601 | 30 | 3 | 26 | STURT | 50 | 2 | 22 | MAKI | 50 | 2 |
| 3 | 39 | YARRUM | 30 | 3 | 28 | OZP0602 | 50 | 2 | 29 | OZP0703 | 30 | 2 |
| 4 | 40 | YARRUM | 50 | 3 | 27 | OZP0602 | 30 | 2 | 30 | OZP0703 | 50 | 2 |
| 5 | 46 | OZP0703 | 50 | 3 | 20 | KASPA | 50 | 2 | 23 | YARRUM | 30 | 2 |
| 6 | 45 | OZP0703 | 30 | 3 | 19 | KASPA | 30 | 2 | 24 | YARRUM | 50 | 2 |
| 7 | 47 | OZP0901 | 30 | 3 | 17 | OZP0601 | 30 | 2 | 32 | OZP0901 | 50 | 2 |
| 8 | 48 | OZP0901 | 50 | 3 | 18 | OZP0601 | 50 | 2 | 31 | OZP0901 | 30 | 2 |
| Buffer | | Buffer | | | | Buffer | | | | Buffer | | |
| Buffer | | Buffer | | | | Buffer | | | | Buffer | | |
| 9 | 22 | MAKI | 50 | 2 | 1 | OZP0601 | 30 | 1 | 6 | MAKI | 50 | 1 |
| 10 | 21 | MAKI | 30 | 2 | 2 | OZP0601 | 50 | 1 | 5 | MAKI | 30 | 1 |
| 11 | 28 | OZP0602 | 50 | 2 | 8 | YARRUM | 50 | 1 | 3 | KASPA | 30 | 1 |
| 12 | 27 | OZP0602 | 30 | 2 | 7 | YARRUM | 30 | 1 | 4 | KASPA | 50 | 1 |
| 13 | 29 | OZP0703 | 30 | 2 | 12 | OZP0602 | 50 | 1 | 15 | OZP0901 | 30 | 1 |
| 14 | 30 | OZP0703 | 50 | 2 | 11 | OZP0602 | 30 | 1 | 16 | OZP0901 | 50 | 1 |
| 15 | 20 | KASPA | 50 | 2 | 10 | STURT | 50 | 1 | 14 | OZP0703 | 50 | 1 |
| 16 | 19 | KASPA | 30 | 2 | 9 | STURT | 30 | 1 | 13 | OZP0703 | 30 | 1 |
| Buffer | | Buffer | | | | Buffer | | | | Buffer | | |
| Buffer | | Buffer | | | | Buffer | | | | Buffer | | |
| 17 | 3 | KASPA | 30 | 1 | 39 | YARRUM | 30 | 3 | 46 | OZP0703 | 50 | 3 |
| 18 | 4 | KASPA | 50 | 1 | 40 | YARRUM | 50 | 3 | 45 | OZP0703 | 30 | 3 |
| 19 | 13 | OZP0703 | 30 | 1 | 41 | STURT | 30 | 3 | 36 | KASPA | 50 | 3 |
| 20 | 14 | OZP0703 | 50 | 1 | 42 | STURT | 50 | 3 | 35 | KASPA | 30 | 3 |
| 21 | 9 | STURT | 30 | 1 | 48 | OZP0901 | 50 | 3 | 38 | MAKI | 50 | 3 |
| 22 | 10 | STURT | 50 | 1 | 47 | OZP0901 | 30 | 3 | 37 | MAKI | 30 | 3 |
| 23 | 16 | OZP0901 | 50 | 1 | 44 | OZP0602 | 50 | 3 | 34 | OZP0601 | 50 | 3 |
| 24 | 15 | OZP0901 | 30 | 1 | 43 | OZP0602 | 30 | 3 | 33 | OZP0601 | 30 | 3 |
| Buffer | | Buffer | | | | Buffer | | | | Buffer | | |

## Results

| Term | Df | denDF | F | Prob |
|---|---|---|---|---|
| VAR | 7 | 39.6 | 12.970 | <0.001 |
| ST | 2 | 30.2 | 181.100 | <0.001 |
| SR | 1 | 42.2 | 0.009 | n.s. |
| VAR:ST | 14 | 39 | 3.734 | <0.001 |
| VAR:SR | 7 | 43.4 | 1.497 | n.s. |
| ST:SR | 2 | 43.3 | 1.918 | n.s. |
| VAR:ST:SR | 14 | 41.7 | 1.184 | n.s. |

All interaction with sowing rate were non-significant, also the main effect of sowing rate was not significant. Both the interaction of variety and sowing time and their main effects were highly significant.

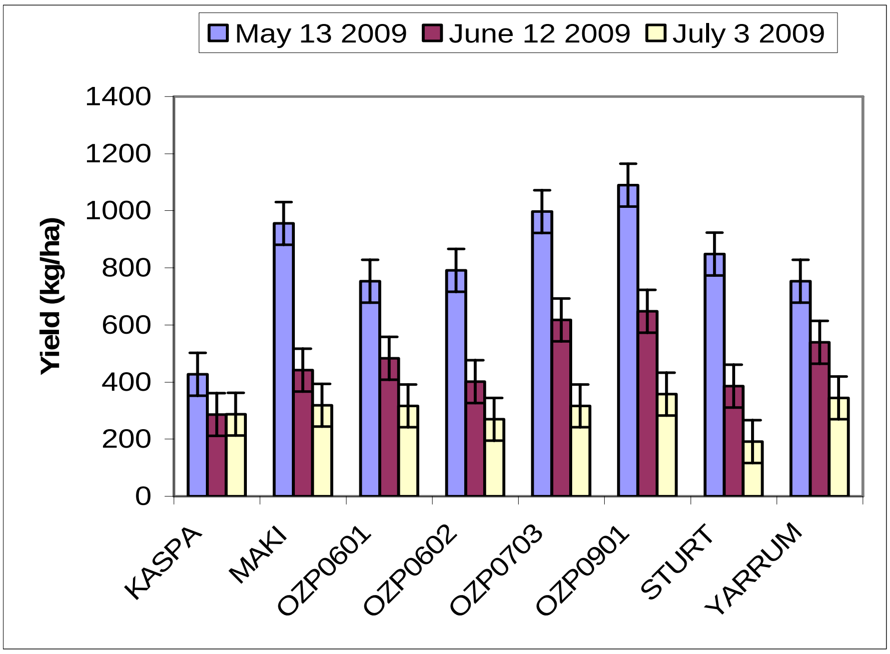


Figure 2.1: The effects of sowing time and variety averaged across plant populations on fieldpea yields at Yenda NSW 2009

**Discussion**

As can be seen in figure 2.1, there was a highly significant effect of sowing time across all varieties. The first sowing of 13$^{th}$ May showed huge yield increase over the remaining 2 sowing times. The mean yield across varieties was 42% higher for the May sowing compared to the June sowing, which were 37% higher then the July sowing.

Whilst there was a significant yield advance in sowing early, these overall yield levels were still relatively low across all treatments especially with longer maturity types like Kaspa. This can be explained by the very poor finish and drought conditions at Yenda in 2009.

Of varieties in this trial OZP0901, OZP0703 and Maki were the significantly highest yielding. The remaining were significantly lower yielding then these 3 varieties, with the exception of Kaspa which was significantly lower yielding then all varieties.

From this trial in a season like 2009, early sown and the correct variety selection of fieldpea maximised grain yields. However this may vary in the average to above average rainfall season as disease (Bacterial Blight) could potentially have a yield effect on these early sown treatments.

There was no yield advantage or disadvantage between 30 and 50 plants/m$^2$, therefore suggesting 30plant/m$^2$ is an adequate plant population to maximise yields.

**Trial 2: Field Pea Plant Population Trial, Yenda, NSW**

***Aim:*** To test the yield response of new varieties and advanced lines of fieldpeas to changes in plant populations in south western NSW. The information from this trial plus others is used to validate and improve grower recommendations.

8 Fieldpea varieties x 5 targeted plant populations

| **Treatments** | | |
|---|---|---|
| Variety | Targeted plant population | Sowing date |
| Kaspa | $16/m^2$ | May 15th 2009 |
| Yarrum | $32/m^2$ | |
| OZP0703 | $48/m^2$ | |
| OZP0601 | $64/m^2$ | |
| OZP0602 | $80/m^2$ | |
| OZP0901 | | |
| Sturt | | |
| Maki | | |

**Results**

The main effects of variety and plant density were highly significant. There was a distinct and significant curvature response to increasing densities and this effect was similar across all varieties.

### Discussion

Yield was maximised in all varieties with plant densities up to 30 plants/$m^2$. However, as densities increased beyond this, yield declined. This more or less reflected the tough conditions experienced as restricted moisture was insufficient to support higher plant numbers and convert this to yield.

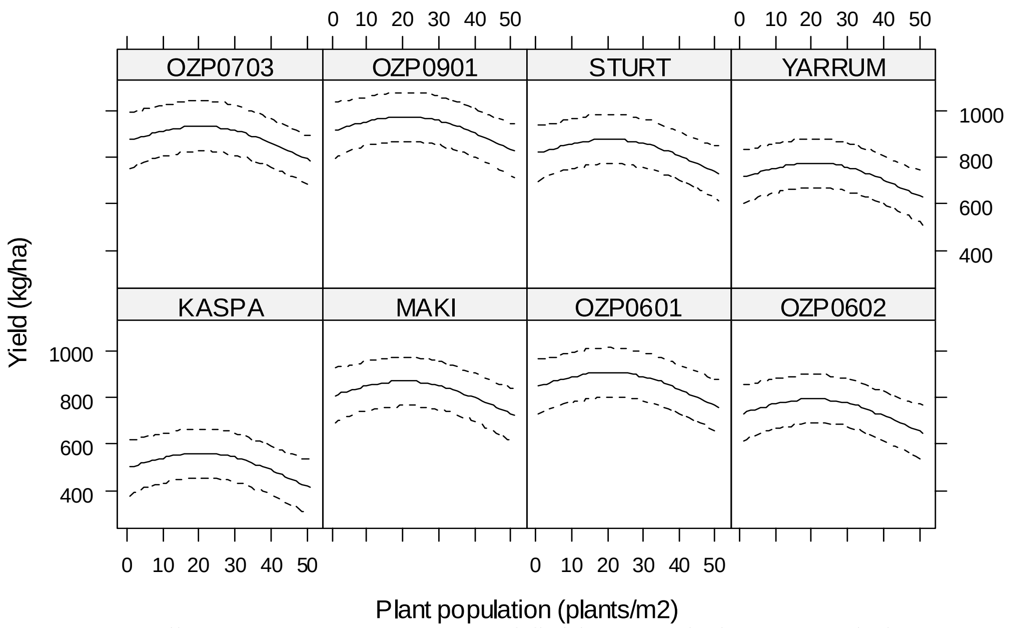


Figure 2.2. Seeding rate response curves of field pea varieties at Yenda in 2009.

## Trial 3: Field Pea Plant Population, Wagga Wagga, NSW

***Aim:*** To test the yield response of new varieties and advanced lines of fieldpeas to changes in plant populations in southern NSW. The information from this trial plus others is used to validate and improve grower recommendations.

8 Fieldpea varieties x 5 targeted plant populations

| **Treatments** | | |
|---|---|---|
| Variety | Targeted plant population | Sowing date |
| Kaspa | 16/m$^2$ | May 27$^{th}$ 2009 |
| Yarrum | 32/m$^2$ | |
| OZP0703 | 48/m$^2$ | |
| OZP0601 | 64/m$^2$ | |
| OZP0602 | 80/m$^2$ | |
| OZP0901 | | |
| Sturt | | |
| Maki | | |

**Trial Design**

| | REP1 | | | | | | REP2 | | | | | | REP3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RANGE1 | | | RANGE2 | | | RANGE3 | | | RANGE4 | | | RANGE5 | | | RANGE6 | | |
| ROW | TRT | Variety | Pop | | | | | | | | | | | | | | | |
| | | Buffer | | | Buffer | | | Buffer | | | Buffer | | | Buffer | | | Buffer | |
| 1 | 21 | OZP0601 | 16 | 11 | STURT | 16 | 38 | OZP0901 | 48 | 29 | OZP0602 | 64 | 5 | KASPA | 80 | 31 | OZP0703 | 16 |
| 2 | 24 | OZP0601 | 64 | 14 | STURT | 64 | 39 | OZP0901 | 64 | 26 | OZP0602 | 16 | 4 | KASPA | 64 | 34 | OZP0703 | 64 |
| 3 | 25 | OZP0601 | 80 | 12 | STURT | 32 | 36 | OZP0901 | 16 | 30 | OZP0602 | 80 | 2 | KASPA | 32 | 32 | OZP0703 | 32 |
| 4 | 22 | OZP0601 | 32 | 13 | STURT | 48 | 40 | OZP0901 | 80 | 28 | OZP0602 | 48 | 1 | KASPA | 16 | 33 | OZP0703 | 48 |
| 5 | 23 | OZP0601 | 48 | 15 | STURT | 80 | 37 | OZP0901 | 32 | 27 | OZP0602 | 32 | 3 | KASPA | 48 | 35 | OZP0703 | 80 |
| 6 | 6 | MAKI | 16 | 17 | YARRUM | 32 | 13 | STURT | 48 | 35 | OZP0703 | 80 | 24 | OZP0601 | 64 | 37 | OZP0901 | 32 |
| 7 | 8 | MAKI | 48 | 19 | YARRUM | 64 | 14 | STURT | 64 | 32 | OZP0703 | 32 | 22 | OZP0601 | 32 | 39 | OZP0901 | 64 |
| 8 | 9 | MAKI | 64 | 20 | YARRUM | 80 | 12 | STURT | 32 | 31 | OZP0703 | 16 | 23 | OZP0601 | 48 | 40 | OZP0901 | 80 |
| 9 | 7 | MAKI | 32 | 16 | YARRUM | 16 | 15 | STURT | 80 | 33 | OZP0703 | 48 | 25 | OZP0601 | 80 | 38 | OZP0901 | 48 |
| 10 | 10 | MAKI | 80 | 18 | YARRUM | 48 | 11 | STURT | 16 | 34 | OZP0703 | 64 | 21 | OZP0601 | 16 | 36 | OZP0901 | 16 |
| 11 | 34 | OZP0703 | 64 | 40 | OZP0901 | 80 | 2 | KASPA | 32 | 16 | YARRUM | 16 | 26 | OZP0602 | 16 | 6 | MAKI | 16 |
| 12 | 35 | OZP0703 | 80 | 38 | OZP0901 | 48 | 4 | KASPA | 64 | 17 | YARRUM | 32 | 30 | OZP0602 | 80 | 9 | MAKI | 64 |
| 13 | 31 | OZP0703 | 16 | 39 | OZP0901 | 64 | 3 | KASPA | 48 | 20 | YARRUM | 80 | 27 | OZP0602 | 32 | 10 | MAKI | 80 |
| 14 | 32 | OZP0703 | 32 | 37 | OZP0901 | 32 | 1 | KASPA | 16 | 18 | YARRUM | 48 | 29 | OZP0602 | 64 | 8 | MAKI | 48 |
| 15 | 33 | OZP0703 | 48 | 36 | OZP0901 | 16 | 5 | KASPA | 80 | 19 | YARRUM | 64 | 28 | OZP0602 | 48 | 7 | MAKI | 32 |
| 16 | 4 | KASPA | 64 | 28 | OZP0602 | 48 | 8 | MAKI | 48 | 25 | OZP0601 | 80 | 20 | YARRUM | 80 | 14 | STURT | 64 |
| 17 | 5 | KASPA | 80 | 26 | OZP0602 | 16 | 9 | MAKI | 64 | 24 | OZP0601 | 64 | 18 | YARRUM | 48 | 15 | STURT | 80 |
| 18 | 3 | KASPA | 48 | 29 | OZP0602 | 64 | 7 | MAKI | 32 | 23 | OZP0601 | 48 | 17 | YARRUM | 32 | 11 | STURT | 16 |
| 19 | 2 | KASPA | 32 | 27 | OZP0602 | 32 | 6 | MAKI | 16 | 21 | OZP0601 | 16 | 19 | YARRUM | 64 | 13 | STURT | 48 |
| 20 | 1 | KASPA | 16 | 30 | OZP0602 | 80 | 10 | MAKI | 80 | 22 | OZP0601 | 32 | 16 | YARRUM | 16 | 12 | STURT | 32 |
| | | Buffer | | | Buffer | | | Buffer | | | Buffer | | | Buffer | | | Buffer | |

### Results

The main effects of variety and plant density were highly significant. There was a distinct and significant curvature response to increasing densities with some varieties showing greater yield increase with increase populations.

### Discussion

As can be seen in figure 2.3, grain yields increased rapidly up until approximately 30-35 plants/m2. From this point no grain yield increases were detected.

The only exception is with variety Sturt, as it continued to show grain yield increase up to 70plants/m$^2$. In this case grain yield would be strongly related to total dry matter produced by Sturt. This result well supports Sturt's suitability in the western fieldpea growing areas particularly the lower rainfall area, as 2009 was a relatively poor season for rainfall and warm spring conditions. However Sturt may have responded differently under wetter seasonal condition, so caution is advised when planting very high populations as bacterial blight may impact yield and be more likely under high plant populations.

There were varietal differences detected with Maki and Kaspa yields significantly lower. Given the season, this was expected of Kaspa but not Maki. Further investigations determined that Maki had very poor establishment issues and therefore this trend is not considered correct for Maki.

All other varieties showed smaller variations in yields and were significantly higher then Kaspa.

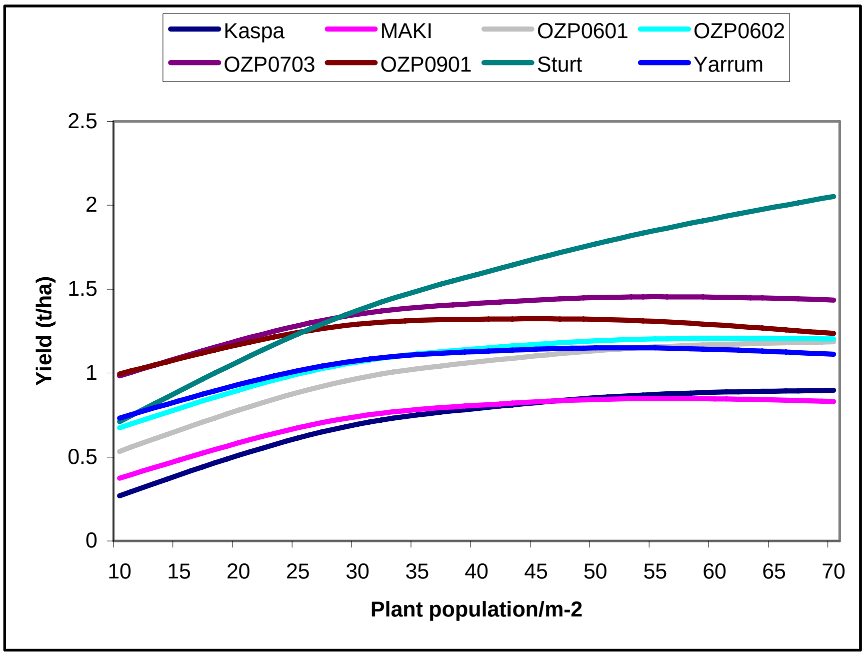


Figure 2.3 The variety x plant populations mean grain yield curvature response for fieldpeas at Wagga Wagga NSW 2009.

## Trial 4: Field Pea Row Spacing, Yenda, NSW

***Aim:*** To investigate the effects of row spacing and plant populations across a range of advanced varieties on yields of fieldpea at Yenda in south western NSW

5 fieldpea varieties x 2 targeted plant populations x 4 rows spacing configurations

**Treatments**

| Variety | Row spacing | Targeted plant population | Sowing date |
|---|---|---|---|
| Kaspa | 20cm | 25 plant/$m^2$ | June $12^{th}$ 2009 |
| OZP0703 | 30cm | 40 plant/$m^2$ | |
| OZP0602 | 40cm | | |
| Sturt | 50cm | | |

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1 | 30_OZP0602_40cm | 50_OZP0602_40cm | 30_Kaspa_40cm | 50_OZP0703_40cm | 50_Sturt_40cm | 30_Sturt_40cm |
| 2 | 30_Kaspa_50cm | 30_OZP0703_50cm | 50_Kaspa_50cm | 30_Sturt_50cm | 50_OZP0703_50cm | 50_OZP0602_50cm |
| 3 | 50_Sturt_20cm | 50_OZP0602_20cm | 30_Sturt_20cm | 30_Kaspa_20cm | 30_OZP0602_20cm | 50_Kaspa_20cm |
| 4 | 50_OZP0602_30cm | 30_OZP0602_30cm | 50_Kaspa_30cm | 30_OZP0703_30cm | 50_OZP0703_30cm | 30_Kaspa_30cm |
| 5 | 50_OZP0703_40cm | 30_OZP0703_40cm | 30_Sturt_40cm | 50_OZP0602_40cm | 50_Kaspa_40cm | 30_Kaspa_40cm |
| 6 | 50_OZP0703_20cm | 30_OZP0602_20cm | 30_OZP0703_20cm | 50_Kaspa_20cm | 50_OZP0602_20cm | 30_Kaspa_20cm |
| 7 | 30_Kaspa_30cm | 30_Sturt_30cm | 50_Sturt_30cm | 50_OZP0703_30cm | 50_OZP0602_30cm | 50_Kaspa_30cm |
| 8 | 30_Sturt_50cm | 50_OZP0703_50cm | 30_OZP0602_50cm | 30_Kaspa_50cm | 50_Sturt_50cm | 50_Kaspa_50cm |
| 9 | 50_Sturt_40cm | 30_Kaspa_40cm | 30_OZP0602_40cm | 50_Kaspa_40cm | 30_OZP0703_40cm | 50_OZP0602_40cm |
| 10 | 50_Sturt_30cm | 30_OZP0703_30cm | 30_Kaspa_30cm | 30_OZP0602_30cm | 30_OZP0703_30cm | 30_Sturt_30cm |
| 11 | 50_Kaspa_20cm | 30_Sturt_20cm | 30_OZP0602_20cm | 50_Sturt_20cm | 30_OZP0703_20cm | 50_OZP0703_20cm |
| 12 | 50_Sturt_50cm | 30_OZP0602_50cm | 50_OZP0602_50cm | 30_OZP0703_50cm | 30_Sturt_50cm | 30_Kaspa_50cm |
| 13 | 30_Kaspa_20cm | 30_OZP0703_20cm | 50_OZP0602_20cm | 50_OZP0703_20cm | 50_Sturt_20cm | 30_Sturt_20cm |
| 14 | 30_Sturt_40cm | 50_Kaspa_40cm | 50_Sturt_40cm | 30_OZP0703_40cm | 30_OZP0602_40cm | 50_OZP0703_40cm |
| 15 | 50_OZP0703_30cm | 50_Kaspa_30cm | 30_Sturt_30cm | 50_OZP0602_30cm | 50_Sturt_30cm | 30_OZP0602_30cm |
| 16 | 50_Kaspa_50cm | 50_OZP0602_50cm | 50_Sturt_50cm | 50_OZP0703_50cm | 30_OZP0703_50cm | 30_OZP0602_50cm |

Note: All plots are double plots (2 runs per plot)

**Analysis**

| Term | Df | denDF | F | Prob |
|---|---|---|---|---|
| VAR | 3 | 45.1 | 152 | <0.001 |
| POP | 1 | 44 | 36.73 | <0.001 |
| SPACE | 3 | 10.9 | 4.579 | <0.05 |
| VAR:POP | 3 | 44.5 | 7.172 | <0.001 |
| VAR:SPACE | 9 | 41.1 | 2.241 | <0.05 |
| POP:SPACE | 3 | 44.8 | 1.362 | n.s. |
| VAR:POP:SPACE | 9 | 42.4 | 1.102 | n.s. |

The full three interactions and the interaction of plant population and row spacing were not significant. All other interactions and main effects were either highly significant or significant.

### Results

Whilst there was significant effects and interaction detected in this trial, there was an underlying effect of metribuzin chemical damage across entire trial causing establishment issues and hence reduced overall yield levels. This occurred due to the site's characteristically sandy soils and very heavy high rainfall event immediately after sowing. This trail was sown at the same time as the Chickpea row spacing trial and both had very similar issues. The metribuzin was applied post-sowing pre-emergence which in hindsight likely increased the severity of damage to the trial because of the very heavy rainfall immediately after spraying. This combined with drought spring conditions resulted in little time for yield compensation.

However useful results were still achieved. Variety wise, OZP0703 (figure 2.4) outperformed all other varieties across all treatments.OZP0703 average yield was 505kg/ha, followed by OZP0602 331kg/ha, Sturt 271kg/ha and Kaspa 269kg/ha. There was a population effect detected but due to the metribuzin damage the established plant population was well below the targeted population.

At these low yield levels it is difficult to weight small differences across row spacing and populations.However when compared to previous work conducted, 20cm and 30cm generally provided the best opportunity to maximise grain yields across varying conditions and seasonal extremes.

Further work is required in this area especially across new varieties, soil profile conditions and populations.

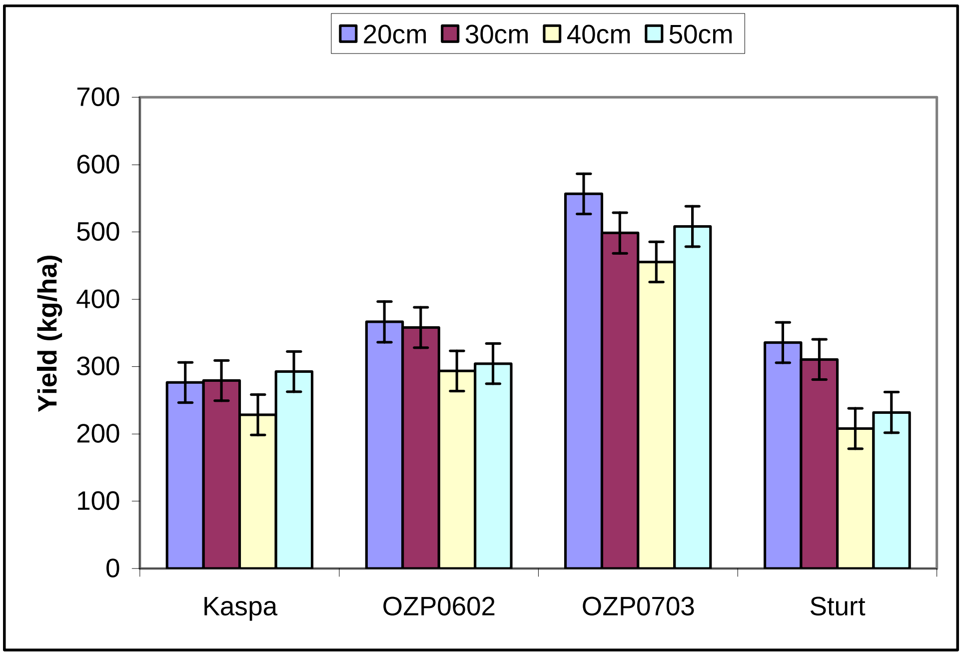


Figure 2.4: The significant response of variety x row spacing (averaged across 2 targeted plant populations and 3 reps)

## Milestone 5 – 30/3/2009

Trials sown to determine optimum sowing dates and plant densities of in the new green and red lentil varieties with improved ascochyta blight and botrytis resistance. New varieties will be compared with Nugget for at least 3 sowing dates and at least 4 plant densities. Establishment, flowering time, grain yield and seed quality attributes will be reported.

**TRIAL 1 and 2: Lentil Plant Density x Sowing Date, Wimmera (Horsham), Victoria**

Please see genotype x management research in *milestone 14*. Trials 2.1 and 2.2.

## Milestone 6 – 30/3/2009

Trials sown to determine herbicide tolerance of new lentil and chickpea varieties inter-row sown into standing stubble as per table above. New varieties will be compared with Nugget or Genesis090 for at least 3 disease management strategies. Flowering time, disease severity, grain yield and seed quality attributes will be reported.

**TRIAL 1: Chickpea Herbicide Tolerance, Wimmera (Dimboola), Victoria**

Treatments

- Varieties (Genesis090, Genesis079, Genesis114, CICA0603 and PBASlasher)
- Treatments

Table 6.1 Herbicide treatments used for herbicide tolerance trials at Horsham in 2008

| Herbicide Treatment (active ingredient and formulation) | Application Rate | Application Timing[1] |
|---|---|---|
| Trifluralin 480 | 1000 ml/ha | PS |
| Trifluralin 480 | 2000 ml/ha | PS |
| Metolachlor 720 | 1000 ml/ha | PS |
| Metolachlor 720 | 2000 ml/ha | PS |
| Metribuzin 750 | 280 g/ha | PSPE |
| Metribuzin 750 | 560 g/ha | PSPE |
| Simazine 900[2] | 1000 g/ha | PSPE |
| Simazine 900 | 2000 g/ha | PSPE |
| Simazine 900 + Diuron 900 | 800 g/ha + 450 g/ha | PSPE |
| Simazine 900 + Diuron 900 | 1600 g/ha + 900 g/ha | PSPE |
| Simazine 900 + Isoxaflutole 750 | 800 g/ha + 100 g/ha | PSPE |
| Simazine 900 + Isoxaflutole 750 | 1600 g/ha + 200 g/ha | PSPE |
| Simazine 900 + Isoxaflutole 750 | 1600 g/ha + 200 g/ha | PS |
| Simazine 900 + Metribuzin 750 | 800 g/ha + 280 g/ha | PSPE |
| Simazine 900 + Metribuzin 750 | 1600 g/ha + 560 g/ha | PSPE |
| Simazine 900 + Imazethapyr 700 | 800 g/ha + 45 g/ha | PSPE |
| Simazine 900 + Imazethapyr 700 | 1600 g/ha + 90 g/ha | PSPE |
| Simazine 900 + Imazethapyr 700 | 1600 g/ha + 90 g/ha | PS |
| Flumetsulam 800 | 25 g/ha | PEb |
| Flumetsulam 800 | 50 g/ha | PEb |

1. PS, Pre Sowing; PSPE, Post Sowing Pre Emergent; PEb, Post Emergent (5 node stage of crop).
2. Simazine 900 at 1000 g/ha is used as the control treatment.

### Results and interpretation

- Key Message: Simazine + imazethapyr applied at the double rate PSPE, reduced yield significantly in all varieties. There were no significant differences between varieties in 2009.
- Climate – See Milestone 14
- Plant establishment – There were no differences in establishment between varieties and herbicide treatments (Data not shown).
- Herbicide damage – Varieties showed a similar level of damage in response to herbicides. Significant symptoms of herbicide damage were recorded for simazine + imazethapyr applied at both double rates PSPE (Table 6.2).
- Weed populations – deadnettle was present at the site and relatively evenly distributed throughout the trial. It was controlled through additional applications of flumetsulam.
- Grain yield – All varieties responded similarly to herbicide application in 2009. The only highly significant reduction in yield occurred in the simazine + imazethapyr treatment applied at double rate PSPE (Table 6.2).

Table 6.2. Herbicide damage symptoms (1 – no symptoms, 9 – complete death) and grain yield (t/ha) of chickpeas for each of the herbicide treatments at Minyip in 2009. As there were no differences in herbicide damage across varieties, it has be averaged for each herbicide treatment.

| Herbicide Treatment | Herbicide Damage | Grain Yield (t/ha) PBASlasher | CICA0603 | Genesis079 | Genesis090 | Genesis114 | Mean |
|---|---|---|---|---|---|---|---|
| Trif, (1000), PS | 1.0 | 1.04 | 1.04 | 0.85 | 0.81 | 0.62 | 0.87 |
| Trif, (2000), PS | 1.0 | 1.02 | 0.93 | 1.04 | 0.79 | 0.58 | 0.87 |
| Meto, (1000), PS | 1.0 | 0.81 | 1.04 | 1.04 | 0.98 | 0.47 | 0.87 |
| Meto, (2000), PS | 1.3 | 0.94 | 1.03 | 0.87 | 0.66 | 0.50 | 0.80 |
| Metri, (280), PSPE | 1.0 | 1.05 | 1.14 | 0.95 | 0.89 | 0.60 | 0.93 |
| Metri, (560), PSPE | 1.0 | 0.95 | 1.00 | 0.86 | 0.86 | 0.64 | 0.86 |
| Sim, (1000), PSPE | 1.0 | 1.05 | 1.07 | 0.90 | 0.83 | 0.70 | 0.91 |
| Sim, (2000), PSPE | 1.0 | 1.11 | 1.04 | 0.95 | 0.82 | 0.55 | 0.90 |
| Sim + Diu, (800+450), PSPE | 1.0 | 1.07 | 1.04 | 1.03 | 0.93 | 0.46 | 0.91 |
| Sim + Diu, (1600+900), PSPE | 1.0 | 1.11 | 0.99 | 0.88 | 0.85 | 0.61 | 0.89 |
| Sim + Iso, (800+100), PSPE | 1.0 | 1.09 | 1.06 | 0.96 | 0.93 | 0.61 | 0.93 |
| Sim + Iso, (1600+200), PSPE | 1.0 | 1.04 | 1.01 | 0.95 | 0.75 | 0.59 | 0.87 |
| Sim + Iso, (1600+200), PS | 1.0 | 1.10 | 0.97 | 0.90 | 0.87 | 0.70 | 0.91 |
| Sim + Prom, (800+1500), PSPE | 1.0 | 1.04 | 0.96 | 1.00 | 0.76 | 0.56 | 0.86 |
| Sim + Prom, (1600+3000), PSPE | 1.0 | 1.16 | 0.94 | 0.96 | 0.82 | 0.57 | 0.89 |
| Sim + Ima, (800+45), PSPE | 1.0 | 1.07 | 1.13 | 0.84 | 0.75 | 0.50 | 0.86 |
| Sim + Ima, (1600+90), PSPE | 2.0 | 0.83 | 0.81 | 0.73 | 0.71 | 0.41 | 0.70 |
| Sim + Ima, (1600+90), PS | 1.0 | 0.94 | 1.00 | 0.78 | 0.76 | 0.46 | 0.79 |
| Flum (25), Peb | 1.0 | 0.84 | 1.02 | 0.78 | 0.82 | 0.57 | 0.81 |
| Flum (50), Peb | 1.0 | 0.98 | 1.01 | 1.00 | 0.82 | 0.46 | 0.85 |
| Mean | | 1.01 | 1.01 | 0.91 | 0.82 | 0.56 | |

Grain yield: $lsd_{(genotype)}$ – 0.05, $lsd_{(herbicide)}$ – 0.10.

# Milestone 7 – 30/3/2009

Trials sown to determine optimum disease management strategy at different sowing times, in the new green and red lentil varieties with improved ascochyta blight and botrytis resistance as per table above. New varieties will be compared with Nugget for at least 3 disease management strategies and 2 sowing times. Flowering time, disease severity, grain yield and seed quality attributes will be reported.

**TRIAL 1 and 2: Lentil Disease Management x Time of Sowing, Paskeville & Maitland, Yorke Peninsula, SA**

**Treatments**

Varieties: Boomer, PBAFlash, PBABounty, CIPAL610, Nipper, Nugget, Northfield (Maitland only)

Sowing dates: Paskeville – 7 May, 27 May, 18 June
Maitland - 6 May, 27 May, 17 June

Fungicides: **Nil** – no fungicide treatments
**Canopy Closure** - Carbendazim (500ml/ha) at canopy closure + at observation of BGM symptoms, Chlorothalonil at mid podding
**Weather** - Carbendazim (500ml/ha) when temperatures are conducive for BGM + at observation of BGM symptoms, Chlorothalonil (2L/ha) at mid podding
**Complete** - Carbendazim (500ml/ha) at canopy closure or conducive weather (whichever first) + at observation of BGM symptoms, Chlorothalonil (2L/ha) at early flower + early pod

Fertiliser: MAP + Zn @ 90kg/ha at sowing

**Results and Interpretation**

Early sown (6-7th May) lentils consistently yielded highest at both sites, averaging 16% and 22% higher than mid sown (27th May), and 59% and 71% higher than late sown lentils (17-18th June) at Paskeville and Maitland, respectively.
At Paskeville the very early maturing line CIPAL610 performed best at early and mid sowing dates (Table 1), followed by PBAFlash, but both varieties yielded similarly when sown later. Nugget yielded lowest at the early and mid sowing dates, and Boomer and Nipper at the latest date.
At Maitland the new release PBAFlash yielded equal highest with Nugget at the early sowing date and was the highest yielding variety at the mid and late sowing dates (Table 2). The other varieties had variable but lower yields across the three sowing dates.

**Table 1:** Effect of sowing date on yield, grain weight, lodging and biomass production of six lentil varieties, Paskeville 2009. Lodging score: 1 = flat, 9 = upright

| | Yield (t/ha) | | | Grain Weight (g/100 seeds) | | | Lodging (1-9 score) | | | Biomass (t DM/ha) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOS | 7th May | 27th May | 18th June | 7th May | 27th May | 18th June | 7th May | 27th May | 18th June | 7th May | 27th May | 18th June |
| Boomer | 3.09 | 2.53 | 1.60 | 5.84 | 5.15 | 4.78 | 2.67 | 3.33 | 4.67 | 11.36 | 9.04 | 5.67 |
| PBAFlash | 3.44 | 3.03 | 2.56 | 4.45 | 4.10 | 3.66 | 6.00 | 6.83 | 7.00 | 9.81 | 9.29 | 6.73 |
| PBABounty | 3.08 | 2.57 | 1.76 | 3.65 | 3.25 | 2.62 | 2.58 | 3.17 | 3.50 | 10.45 | 8.32 | 4.64 |
| CIPAL610 | 4.07 | 3.78 | 2.69 | 5.38 | 5.20 | 4.26 | 6.00 | 7.00 | 7.92 | 11.11 | 9.09 | 6.98 |
| Nipper | 2.85 | 2.38 | 1.66 | 2.77 | 2.51 | 2.31 | 6.92 | 7.92 | 8.00 | 11.16 | 8.79 | 5.06 |
| Nugget | 2.70 | 2.27 | 1.83 | 3.63 | 3.20 | 2.88 | 6.08 | 6.50 | 6.42 | 10.60 | 8.57 | 4.86 |
| LSD (P>0.05) | 0.21 (0.18 same TOS) | | | 0.11 (0.10 same TOS) | | | 0.42 (0.37 same TOS) | | | 1.48 (1.09 same TOS) | | |

**Table 3:** Effect of sowing date on yield, grain weight, lodging and biomass production of seven lentil varieties, Maitland 2009. Lodging score: 1 = flat, 9 = upright

| | Yield (t/ha) | | | Grain Weight (g/100 seeds) | | | Lodging (1-9 score) | | |
|---|---|---|---|---|---|---|---|---|---|
| TOS | 6th May | 27th May | 17th June | 6th May | 27th May | 17th June | 6th May | 27th May | 17th June |
| Boomer | 3.19 | 2.77 | 1.92 | 6.01 | 5.56 | 5.30 | 2.33 | 4.67 | 3.25 |
| PBAFlash | 3.63 | 3.19 | 2.40 | 4.40 | 4.05 | 3.88 | 5.92 | 7.00 | 6.92 |
| PBABounty | 3.41 | 2.68 | 1.85 | 3.38 | 3.15 | 3.01 | 2.75 | 3.50 | 3.00 |
| CIPAL610 | 3.41 | 2.89 | 2.19 | 5.34 | 4.90 | 4.36 | 5.92 | 7.92 | 7.08 |
| Nipper | 3.22 | 2.44 | 1.64 | 2.64 | 2.68 | 2.66 | 6.92 | 8.00 | 7.92 |
| Northfield | 3.04 | 2.59 | 1.84 | 2.75 | 2.65 | 2.68 | 5.42 | 6.42 | 5.17 |
| Nugget | 3.48 | 2.62 | 1.79 | 3.51 | 3.38 | 3.33 | 5.92 | 6.42 | 6.50 |
| LSD (P>0.05) | 0.23 (0.18 same TOS) | | | 0.09 (0.09 same TOS) | | | 0.40 (0.34 same TOS) | | |

There was a consistent reduction in grain weight at Paskeville as sowing was delayed (Table 2), while at Maitland (Table 2) only the varieties, Boomer, PBAFlash, PBABounty and CIPAL610, showed this trend.

Dry matter production at Paskeville in 2009 averaged 21% higher than that measured at Maitland in 2008. Biomass production decreased as sowing date was delayed (Table 1), with early sown lentils averaging 18% and 47% higher in biomass than those sown 3 and 6 weeks later. PBAFlash was the only variety that showed no difference in biomass production between the early and mid sowing dates. There were no variety differences in biomass production at the early and mid sowing dates, however at the late sowing date the earlier maturing varieties PBAFlash and CIPAL610 produced higher levels than PBABounty, Nipper and Nugget.

Foliar disease scores for botrytis grey mould (BGM) at Paskeville showed that the highest disease levels occurred at the early sowing date (Table 4), with little disease present at the late sowing date (results not shown). All fungicide treatments (Canopy, Weather and Complete) were successful in reducing BGM infection in all varieties tested. PBA Bounty, PBA Flash and Nugget had the highest level of BGM infection, while Nipper and CIPAL610 showed the least infection level. In Nipper and CIPAL610 there was no difference in disease levels between the Nil and the fungicide treatments. Canopy and Weather treatments were applied at the same time for the mid and late sowing dates as these treatments reached canopy closure after the conditions were already conducive for BGM progression.

When sown early, all fungicide treatments were effective at increasing yield over the nil treatment regardless of variety. However at the mid sowing date only the 'complete' treatment resulted in significantly increased yield (Figure 1). Fungicides had no effect on yield when sown late.

**Table 4:** Effect of sowing date and fungicide treatment on botrytis grey mould severity at Paskeville, rated 20th Oct 2009. Rating scale 1= no disease, 9 = dead plots LSD = 1.3

| Variety | Sown 7th May | | | | Sown 27th May | | | |
|---|---|---|---|---|---|---|---|---|
| | Nil | Canopy | Weather | Complete | Nil | Canopy | Weather | Complete |
| Boomer | 3.7 | 1.7 | 1.0 | 1.3 | 1.7 | 1.0 | 1.0 | 1.0 |
| PBAFlash | 4.7 | 2.7 | 3.0 | 2.0 | 2.7 | 2.7 | 3.3 | 1.3 |
| PBABounty | 5.7 | 1.3 | 2.3 | 1.3 | 1.3 | 1.7 | 1.3 | 1.3 |
| CIPAL610 | 2.0 | 2.3 | 1.0 | 1.7 | 1.3 | 1.3 | 1.0 | 1.0 |
| Nipper | 1.7 | 1.7 | 2.7 | 1.7 | 1.0 | 1.0 | 1.7 | 1.0 |
| Nugget | 4.7 | 2.3 | 1.7 | 1.0 | 3.3 | 1.0 | 1.0 | 1.0 |

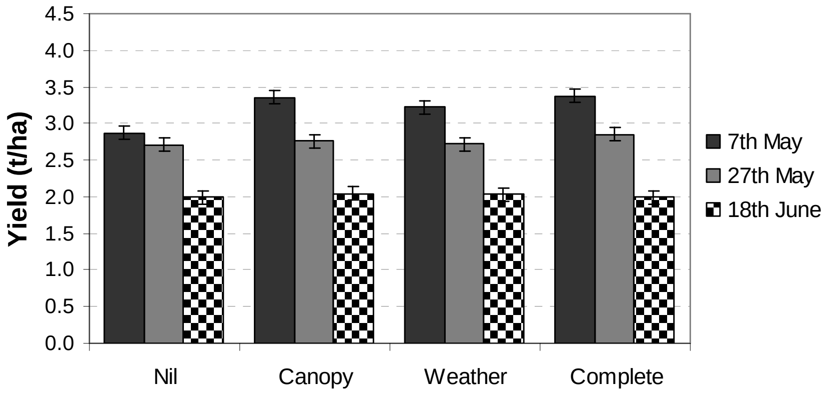


**Figure 1:** Effect of fungicide treatment on yield of lentils at three sowing dates, Paskeville 2009.

The 2009 data was inconclusive in determining whether foliar fungicides for BGM control can be delayed until after the canopy closure stage in situations where conditions are not conducive for disease development at canopy closure (ie less than 10$^{o}$C at night and 18$^{o}$C during the day). Applying just prior to canopy closure allows better penetration into the canopy where humidity is highest and the fungus will be most active, however in early sown crops or bulkier varieties this may be 2-4 weeks before conditions become favourable for BGM progression. In 2009 there was not a lot of difference in timing between canopy closure and the conducive weather conditions and this may have compromised the findings. In the absence of conclusive evidence a canopy closure spray is still recommended regardless of weather conditions and follow up sprays are dependent upon disease progression.

## Key Findings and Comments

- Early sown lentils consistently out-yielding those sown later, as the heat wave event in early November compromised yield of late sown lentil crops by terminating seed fill prematurely.
- The 2009 data was inconclusive in determining whether foliar fungicides for BGM control can be delayed until after the canopy closure stage in situations where conditions are not conducive for disease development at canopy closure (ie less than 10$^{o}$C at night and 18$^{o}$C during the day).
- The rapid finish to the season favoured early maturing varieties PBAFlash and CIPAL610 at both sites, averaging 5-32% above site means across sowing dates.
- Canopy closure sprays with follow up sprays dependent upon disease observation were successful in reducing BGM in all varieties tested at Paskeville, even at the early sowing date.

## Acknowledgments

The assistance of Mark Bennie, John Nairn, Peter Maynard and Rowan Steele, SARDI Clare, with trial management is gratefully acknowledged.

## Milestone 8 – 30/3/2009

Trials sown to determine optimum sowing dates, plant densities and row space for new faba bean varieties as per Table 3. New varieties will be compared with Fiesta for at least 3 sowing dates, 4 plant densities and 2 row spacings. Establishment, flowering time, grain yield and seed quality attributes will be reported.

# Milestone 10 – 30/3/2009

Trials sown to determine optimum disease management strategy at different sowing times, in the new faba bean varieties with improved ascochyta blight and chocolate spot resistance as per table 3. New varieties will be compared with Fiesta for at least 3 disease management strategies and 2 sowing times. Flowering time, disease severity, grain yield and seed quality attributes will be reported.

**TRIAL 1: Faba Bean Time of Sowing x Plant Density x Row Spacing, Tarlee, Mid North, SA**

## Treatments

Sowing dates: 1 May, 22 May
Varieties: Nura, Farah, Fiord, 974*(611*974)/15-1 (abbreviated in text to 974*)
Plant Density: 16, 24 and 32 plants/$m^2$
Row Spacing: Narrow = 22.5cm (9 inch), Wide = 45cm (18 inch)
Fertiliser: MAP + Zn @ 90kg/ha at sowing

### Results and Interpretation

### Trial Results

A four-way interaction occurred between sowing date, row spacing, plant density and variety (Figure 1). Variety yield was generally maximised at the early sowing date and at the narrow row spacing. The taller beans, Farah and breeders line 974*, showed the largest yield increase from early sowing, particularly at the narrow row spacing, averaging 10 and 21% higher across both row spacings. These varieties averaged 13-15% higher on narrow row than on wide row spacings across all plant densities at the early sowing date, compared to 3-5% higher in Fiord and Nura.
Fiord had high levels of disease when sown early, and was the only variety to yield consistently equal or higher when sown late. Nura generally showed no difference in yield between the two sowing dates at the narrow row spacing, but at the wide row spacing it yielded higher at the early sowing date. Plant density appeared to have no consistent effect on yield, except that Nura showed equal or higher yield at the highest plant density.
Grain weight was consistently higher in early sown beans (Figure 2). At both sowing dates grain weight was lowest when sown at 16 plants/$m^2$. Increasing plant density resulted in increased grain weight at the late sowing date, but there was no response past 24 plants/$m^2$ at the early sowing date. Grain weight was also increase at the wide row spacing (Figure 3).

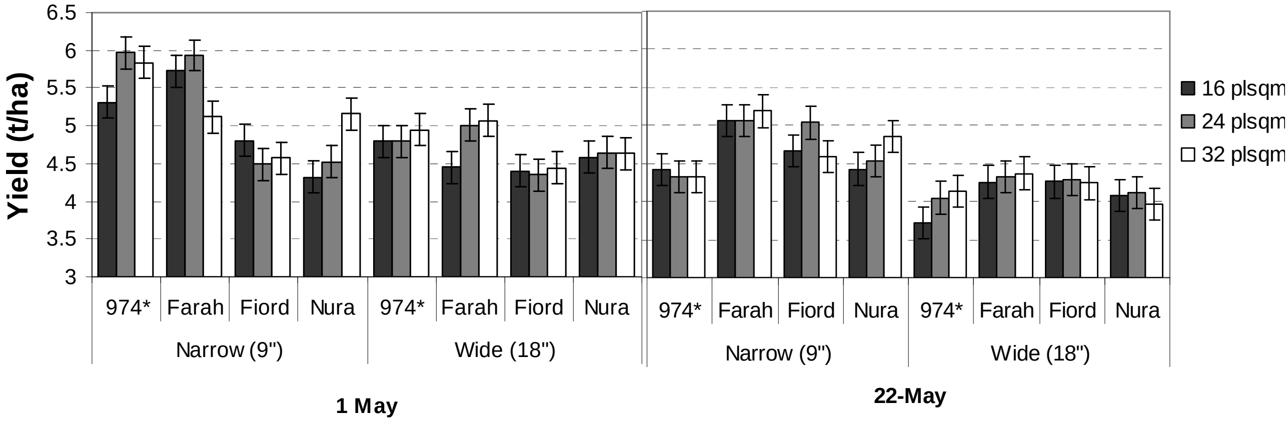


**Figure 1:** Effect of sowing date, row spacing and plant density on yield of four bean varieties, Tarlee 2009.

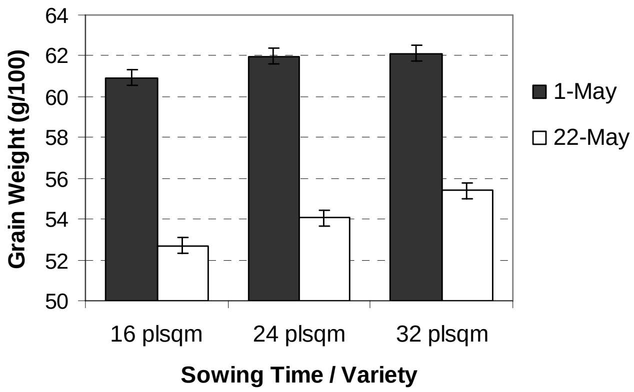


**Figure 2:** Effect of sowing date and plant density on grain weight of Faba beans, Tarlee 2009.

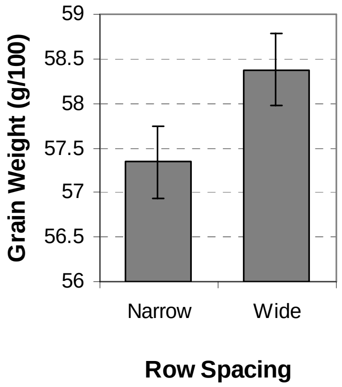


**Figure 3:** Effect of row spacing on grain weight of Faba beans, Tarlee 2009.

All varieties except Fiord produced more biomass across treatments sown early than late, however it is possible that leaf drop caused by higher levels of disease in this variety was initiated prior to sampling (Table 2). Farah and 974* produced more biomass than Fiord at the early sowing date, but there was no difference between varieties at the late sowing date. The highest level of biomass was at the early sowing date on narrow row spacings and at the lowest plant density (Table 3). At the early sowing date more biomass was produced on narrow row spacings, apart from at the high plant density where row spacing made no difference to biomass production. At the late sowing date row spacing had no effect on biomass. Biomass was generally reduced as plant density was increased at both sowing dates and row spacings.

Lodging was increased at early sowing dates (Table 2). Plant density had no effect on lodging in Fiord when sown early, or any variety when sown late. 974* showed the least lodging sown late, but was no different to Fiord and Nura when sown early. Farah showed the highest worst or equal highest lodging across all treatments. Lodging was reduced when sown early at the 16 plants/$m^2$ sowing density compared to other densities, but there were no differences in lodging when sown late (Table 3).

Necking (where the top part of the stem collapses and bends over sharply, but does not break completely) was increased by sowing early, and in some cases by lower plant densities (Figure 4). Row spacing appeared to have little effect on necking scores in 2009.

**Table 2:** The effect of sowing date on biomass production and lodging of four Faba bean varieties, Tarlee 2009. Lodging: 1 = flat, 9 = upright

| Variety | Biomass (g/plant) | | Lodging (1-9 score) | |
|---|---|---|---|---|
| | May 1 | May 22 | May 1 | May 22 |
| **974*** | 69.4 | 45.6 | 6.2 | 8.5 |
| **Farah** | 71.4 | 46.9 | 4.2 | 6.6 |
| **Fiord** | 54.0 | 48.3 | 6.5 | 7.6 |
| **Nura** | 60.0 | 47.6 | 5.7 | 6.7 |
| ***LSD (P<0.05)*** | *11.4 (6.4 same TOS)* | | *0.52 (0.56 same TOS)* | |

**Table 3:** The effect of sowing date, row spacing and plant density on biomass production and lodging of Faba beans, Tarlee 2009. Lodging: 1 = flat, 9 = upright

| Sowing Date | Row Spacing | Biomass (g/plant) | | | Lodging (1-9 score) | | |
|---|---|---|---|---|---|---|---|
| | | 16 plsqm | 24 plsqm | 32 plsqm | 16 plsqm | 24 plsqm | 32 plsqm |
| | **Narrow** | 91.5 | 64.5 | 49.7 | 6.3 | 5.3 | 5.5 |
| **May 1** | **Wide** | 71.1 | 54.2 | 51.1 | 6.7 | 5.6 | 4.7 |
| | **Narrow** | 62.7 | 45.3 | 35.4 | 7.3 | 7.5 | 7.0 |
| **May 22** | **Wide** | 64.4 | 45.0 | 29.8 | 7.5 | 7.4 | 7.4 |
| ***LSD (P<0.05)*** | | *12.0 (10.4 same TOS)* | | | *0.70 (0.80 same TOS)* | | |

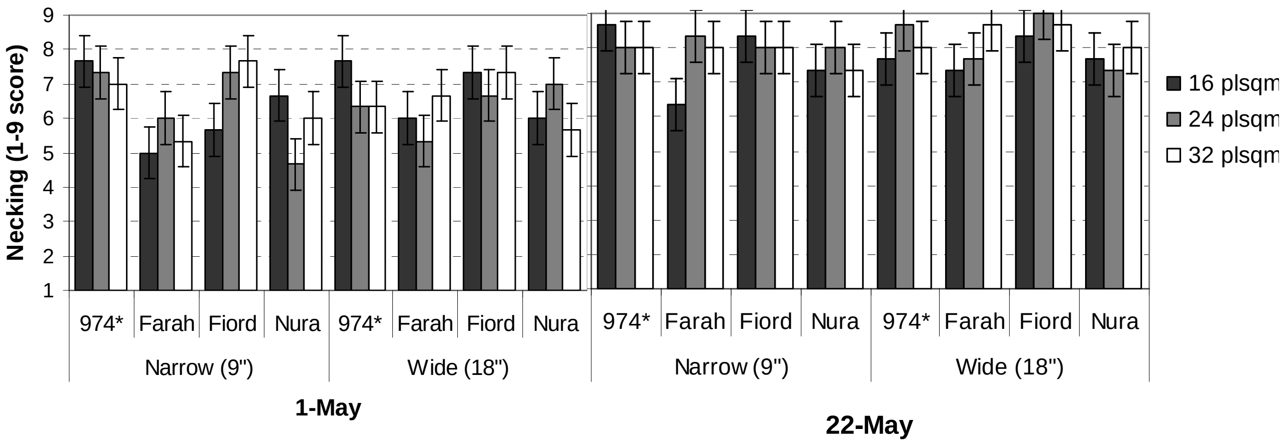


**Figure 4:** Effect of sowing date, row spacing and plant density on necking of four bean varieties, Tarlee 2009. Necking: 1 = 100%, 9 = 0% plot affected

Increasing plant density resulted in increased chocolate spot severity across all varieties (Figure 5). Fiord and Nura showed greater chocolate spot infection than Farah and 974* at the early sowing date (Figure 6). Increasing row spacing decreased chocolate spot severity in Fiord only at the early sowing date. All varieties performed similarly regardless of treatment when sown late. Chocolate spot severity was reduced in Fiord and Nura at the late sowing date compared to the early sowing date, whereas no sowing date response was observed for chocolate spot severity in Farah or 974*.

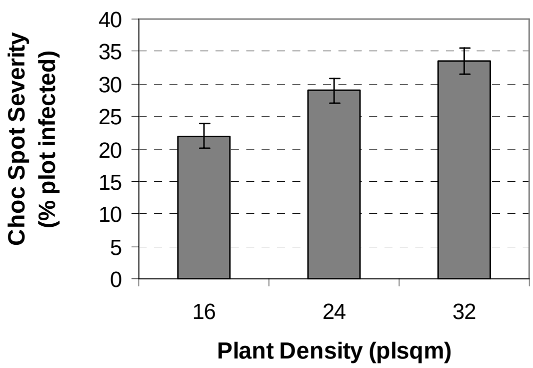


**Figure 5:** Effect of plant density on chocolate spot severity in Faba beans, Tarlee 2009.

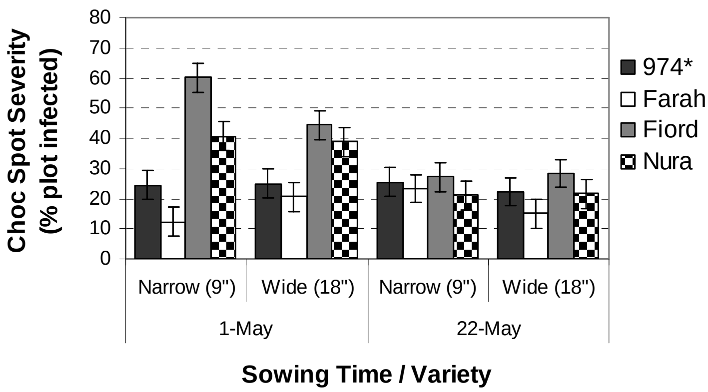


**Figure 6:** Effect of sowing date and row spacing on chocolate spot severity of four Faba bean varieties, Tarlee 2009.

**Key Findings and Comments**

- Winter and early spring seasonal conditions favoured faba bean production in 2009, and yields were more than double those in 2008.
- Yield was generally maximised at the early sowing date and at the narrow row spacing.
- Farah was the highest or equal highest yielding variety at both sowing dates in 2009.
- The taller varieties Farah and 974* showed the largest reduction in yield when row spacing was doubled from 9” to 18”.
- Chocolate spot levels were high in 2009, and accounted for 32% yield loss across varieties in untreated plots. Agronomic techniques that delayed canopy closure (ie later sowing, lower plant densities and wider row spacings) were important in reducing disease severity.

- Nura had higher disease levels and lower grain yield than Fiesta across all treatments in 2009, but a triple chocolate spot spray strategy was effective in reducing yield loss by 25% in both varieties.
- Decreasing plant density was the most significant factor influencing disease levels after delayed sowing, and resulted in lower disease levels across all varieties, and increasing row spacing reduced disease infection in early sown Fiord only.
- Increasing row spacing reduced chocolate spot infection, but only in the susceptible variety Fiord when sown early.

**Acknowledgments**

The assistance of Mark Bennie, John Nairn, Peter Maynard and Rowan Steele, SARDI Clare, with trial management is gratefully acknowledged.

## TRIAL 2: Faba Bean Disease Management, Tarlee, Mid North, SA

**Treatments**

Varieties: Nura, Fiesta

Sowing date: 2 May

Treatments: **Nil** - No fungicides

**Single Asco** – Mancozeb (2kg/ha) at podding only (29/9)

**Double Asco** – Mancozeb at 6 WAS (25/6) + podding (29/9)

**Double Choc Spot** – Carbendazim (500ml/ha) at early flower (13/8) and late flower (6/10)

**Triple Choc Spot** – Carbendazim at early flower (13/8), mid flower (4/9) and late flower (6/10)

**Complete** – fortnightly Chlorothalonil (2.3L/ha) plus Carbendazim (500ml/ha) during flowering

- Mancozeb (430g/kg a.i.) @ 2.2kg/ha
- Chlorothalonil (720 g/L a.i.) @ 2.3L/ha
- Carbendazim (500g/L a.i.) @ 500ml/ha

Fertiliser: MAP + Zn @ 90kg/ha at sowing

**Results and Interpretation**

There was no variety by fungicide strategy interaction, indicating that both Nura and Fiesta behaved the same for each treatment. Yield of Fiesta beans was 10% higher than Nura across all treatments, and chocolate spot measurements also showed 10% less plot infection in Fiesta than Nura (Table 4). Grain weight was also higher in Fiesta than Nura. Treatment differences showed that each spray was effective in reducing chocolate spot severity in both varieties, resulting in increased yield (Table 5). Yield was maximised in the Triple Choc Spot and Complete treatments, which were 25% and 32% higher than the Nil, respectively. Grain weight was highest in the Complete treatment, and lowest in the Nil.

Low levels of ascochyta blight observed early in the year (data not shown) did not develop into an epidemic, and it is unlikely to have influenced yields in 2009.

**Table 4:** Yield, grain weight and chocolate spot severity comparisons for Fiesta and Nura Faba beans, Tarlee 2009.

| Variety | Yield (t/ha) | Grain Weight (g/100) | Chocolate Spot (% plot infected – 22 Oct) |
|---|---|---|---|
| **Fiesta** | 5.17 | 184 | 42 |
| **Nura** | 4.68 | 179 | 52 |
| **LSD (0.05)** | *0.20* | *3.0* | *3.6* |

**Table 5:** Yield, grain weight and chocolate spot severity of Faba beans at Tarlee, 2009.

| Treatment | Yield (t/ha) | Grain Weight (g/100) | Chocolate Spot (% plot infected – 22 Oct) |
|---|---|---|---|
| **Nil** | 4.28 | 178 | 70 |
| **Single Asco** | 4.68 | 184 | 65 |
| **Double Asco** | 4.64 | 181 | 62 |
| **Double Choc spot** | 4.89 | 181 | 48 |
| **Triple Choc spot** | 5.37 | 179 | 28 |
| **Complete** | 5.67 | 187 | 8 |
| **LSD (0.05)** | *0.35* | *5.1* | *6* |

## Key Findings and Comments

- Chocolate spot levels were high in 2009, and accounted for 32% yield loss across varieties in untreated plots.
- Nura had higher disease levels and lower grain yield than Fiesta across all treatments in 2009, but a triple chocolate spot spray strategy was effective in reducing yield loss by 25% in both varieties.

## Acknowledgments

The assistance of Mark Bennie, John Nairn, Peter Maynard and Rowan Steele, SARDI Clare, with trial management is gratefully acknowledged.

# Milestone 14 – 30/3/2009

## GXM EXPERIMENTS

What is genotype x management research?
Genotype refers to the genes that make up the varieties characteristics (e.g. tolerance to disease or abiotic constraints, flowering, growth habits etc). Management refers to all the components of the farming system that we can control that may alter the performance of a variety (e.g. herbicide/fungicide application, sowing time, plant density, row spacing etc.). In research we need to look at both sides of this equation as outlined below:

1. Impact of genetics on farming systems
Genes (or traits) introduced by crop breeders can have significant impacts on the overall profitability and sustainability of the farming system. We need to understand these potential benefits and how to agronomically maximise them. Through PBA many new novel agronomic traits are available or under development to potentially improve yield and adaptation. The physiological and agronomic impact of these can be explored in detail, thereby providing breeders with supportive information for incorporating these into new varieties. For example, several weed management traits are available, including herbicide tolerance (e.g. group B tolerant lentils), early maturing chickpeas or field peas for crop-topping and reduced height and evenness of canopy chickpeas for wickwiping.

2. Impact of farming systems on genetics
Rapid change in farming systems leaves breeding and variety evaluation behind. Often old agronomy is used to select varieties for these new systems. The new farming systems offer new opportunities and challenges for breeding. It is important that genes/traits that confer advantage in these new farming systems be identified to further enhance the profitability of the overall system. For example, no-till cultivation and stubble retention practices are being widely adopted in south-eastern Australia. Traditional varieties have come from breeding trials where stubbles have been burnt and may not have the complete package of traits best suited to these systems.

*Please see Attachment 1 for full protocols of experiments described.*

**1. Row Spacing**

Trials sown to identifying traits which confer agronomic, grain yield and quality advantages in standing stubble and wider row cropping systems for chickpea and lentil. A range of germplasm will be compared in accordance with protocol attachment.

Aim: To investigate the adaptability of a range of lentil and chickpea varieties and breeding lines to inter-row sowing in wider row spacing's than conventional cropping systems. Results from this trial will be used to provide advice to breeders on the characteristics required for modern inter-row and wider row cropping systems. The influence of sowing time and plant density and growth and yield is also investigated in these trials.

*These trial are a comparison of systems, not just row space. In the wider row spacing's plots were sown with narrow lucerne points, press wheels and chemicals applied pre-sowing. In the narrow row spacing's plots were sown with narrow lucerne points, harrows and chemicals applied post-sowing, pre-emergent.*

## TRIAL 1.1: Chickpea Sowing Time x Row Space x Plant Density, Wimmera (Minyip), Victoria

Please note: The research described under this milestone combines with and addresses the research objectives in *milestones 2 and 5*.

### Treatments

- Genotypes - All genotypes in Table 1.1 except Genesis 114, CICA0603 and CICA0604 where used.

Table 1.1. Disease and agronomic characteristics of chickpea genotypes (varieties and advanced breeding lines) used in 2009 trials in Victoria.

| Variety | Ave 100 seed wt (g) | Seed Size (mm) | Vigour | Flowering | Maturity# | Botrytis grey mould | Ascochyta blight | Growth Habit |
|---|---|---|---|---|---|---|---|---|
| ***Desi's*** | | | | | | | | |
| **Sonali** | 18 (16-20) | | Good | Early | Early | S | MS | stick-like |
| **Genesis™ 509** | 16 (15-17) | | Average | Mid | Early/Mid | MS | R | erect |
| **PBA Slasher** | 18 (17-19) | | Average | Mid | Early/Mid | S | R | vase shape |
| **CICA0613** | 20 (?) | | Average | Late | Late | S | MS | very high pods |
| **CICA0603** | 20 (19-21) | | Good | Early | Early | S | MR | |
| **CICA0604** | 18 (16-20) | | Good | Early | Early/Mid | S | MR | |
| **CICA0721** | 20 (?) | | Good | Mid/Late | Mid | S | MR | erect |
| **99-4447G*02H015** | 26 (25-28) | | Good | Mid/Late | Mid | S | MR | vase shape |
| **01040-1057** | 25 (?) | | Good | Late | Late | S | MS | tall, showy |
| **03-024C*04HS003** | 18 (17-20) | | Average | Late | Mid/late | S | R | bunched pods |
| **99226*02HS001** | 18 (15-20) | | Average | Early | Mid/Early | S | MR | short/low pods |
| ***Kabuli's*** | | | | | | | | |
| **Genesis™ 090** | 30 (26-35) | 7-8 | Good | Mid | Mid/late | S | R | bushy |
| **Almaz** | 42 (40-45) | 9 | Average | Late | Late | S | MS | branching |
| **Genesis™ 079** | 26 (24-28) | 6-7 | Good | Early | Early | S | R | prostrate |
| **Genesis™ 114** | 40 (36-43) | 8-9 | Good | Mid | Mid/Late | S* | MR | erect |

Resistant ratings based on resistance relative to Genesis090: R = resistant, MR = moderately resistant, MS = moderately susceptible, S = susceptible

- Sowing Dates (12 May, 16 June)
- Plant Densities (15, 30, 45 plants/m$^2$) – only varieties indicated in Table 1.2.

Table 1.2. Seeding rate (kg/ha) required to achieve target plant densities in chickpeas. Seed weight (g/100 seed) indicated in brackets

| **Plant density (plants/m$^2$)** | **Genesis 090** (30) | **Genesis 509** (15.5) | **Genesis 079** (23.5) | **Almaz** (41) |
|---|---|---|---|---|
| 15 | 47 | 24 | 37 | 65 |
| 30 | 95 | 49 | 74 | 129 |
| 45 | 142 | 73 | 111 | 194 |

- Row Spacings
  1. Inter-row, 30 cm row spacing, standing stubble (ST, 0.30)

.... 2. Inter-row, 60 cm row spacing, standing stubble (ST, 0.60)

.... 3. Inter-row, 30 cm row spacing, slashed stubble (sl, 0.30)

.... 4. 19 cm row spacing, slashed stubble (sl, 0.19)

**Results and Interpretation**

- Key Message: Generally early sowing and higher plant densities resulted in highest yields. Wider row spacing's with standing stubble (60 and 30 cm) produced 10% higher grain yields than slashed stubble treatments (19.5 cm and 30 cm) for chickpeas in 2009.
- Climate - The season in terms of rainfall was characterised by a break in mid May after a very dry summer and autumn. Rainfall was average or above average for the growing season and annually (Table 1.3). After above average winter and early spring rainfall, there was a relatively dry period through October until mid/late November. Maximum temperatures were generally above average throughout the year except for November, where a heat wave was experienced from the 7$^{th}$ – 20$^{th}$ with most days above 35$^{o}$C (Fig 1.1). This heatwave coincided with the dryer conditions described above. Minimum temperatures were below average in October and warmer than average in November (Fig 1.1). No significant frosts were recorded at Horsham during the flowering and podding periods of the pulses.

Table 1.3. Monthly rainfall, growing season rainfall (GSR) and total rainfall (mm) at Minyip and Curyo in 2009 compared with long term averages.

| | **Minyip** | | **Curyo** | |
|---|---|---|---|---|
| **Month** | **2009** | **Average (Horsham)** | **2009** | **Average (Birchip)** |
| Januray | 0.2 | 23.3 | na | 20.5 |
| February | 0 | 24.7 | na | 24.7 |
| March | 11 | 23.3 | na | 23.1 |
| April | 22 | 31.5 | na | 25.2 |
| May | 59.8 | 46.5 | 17.4 | 38.5 |
| June | 58.2 | 49.6 | 44.8 | 38 |
| July | 62 | 46.8 | 35.2 | 38.1 |
| August | 49.2 | 48.5 | 27.6 | 38.5 |
| September | 83 | 46 | 31.6 | 39.2 |
| October | 21.2 | 43.8 | 7.8 | 38.2 |
| November | 61.8 | 33.5 | 55.2 | 26.5 |
| December | 26.2 | 27.7 | 26 | 23.6 |
| GSR (May-Oct) | 333.4 | 281.2 | 219.6 | 228 |
| Total | 455 | 445.2 | na | 375.6 |

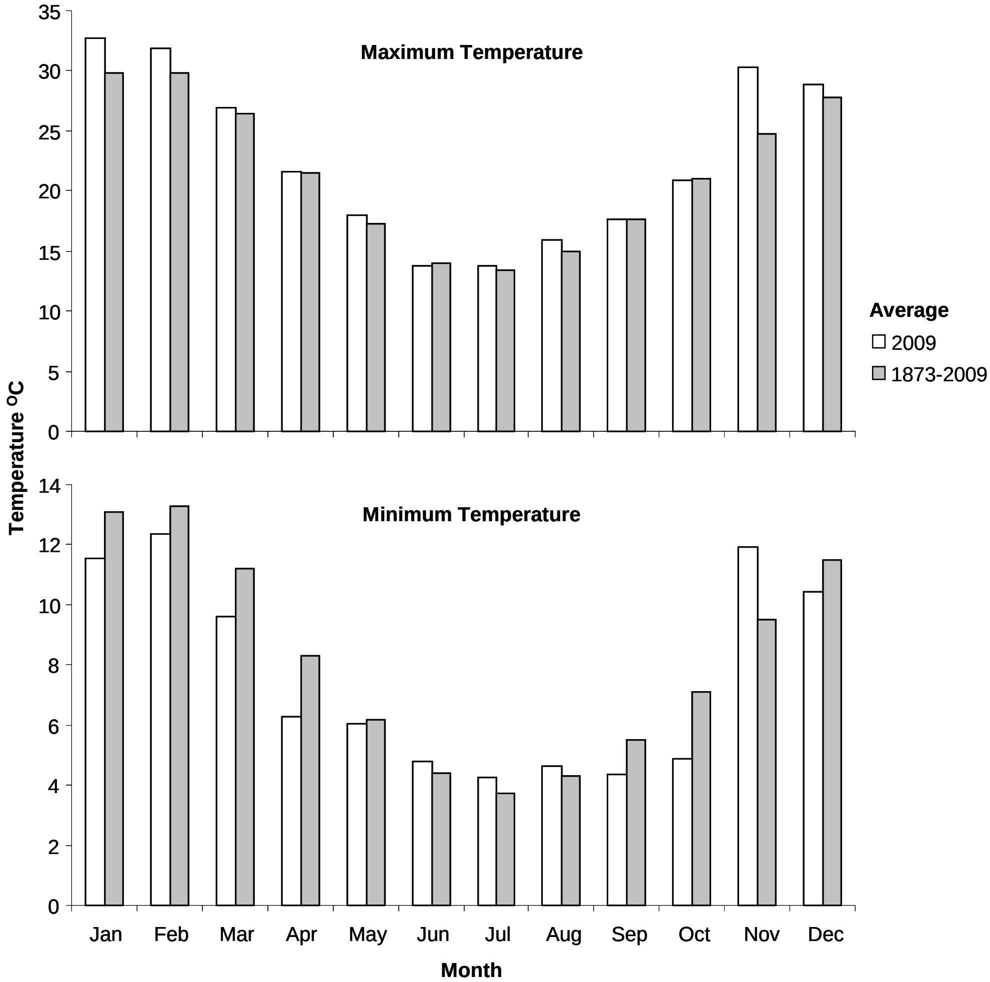


Figure 1.1. Average monthly maximum and minimum temperatures at Horsham in 2009 in comparison with long term data (approximately 100 years) and highest and lowest recorded

- Plant establishment – Similar trends for plant establishment were observed across all genotypes. Generally achieved plant densities were below target plant densities at higher sowing rates (Table 1.4). At wider row spacing's and with delayed sowing, plant density was reduced.

Table 1.4. The main effect of row space, sowing date and sowing rate (plants/m$^2$) on plant establishment (Pl/m$^2$) in chickpeas at Minyip in 2009

| Row Space | Pl/m$^2$ | Sowing Date | Pl/m$^2$ | Sowign Rate | Pl/m$^2$ |
|---|---|---|---|---|---|
| sl, 0.195 | 26 | 12 May | 26 | 15 | 15 |
| sl, 0.3 | 23 | 15 June | 21 | 30 | 23 |
| ST, 0.3 | 23 | | | 45 | 32 |
| ST, 0.6 | 21 | | | | |
| lsd(P<0.05) | 2.5 | | ns | | 2 |

- Crop and Pod Height – Crop height refers to the height at the top of the canopy and pod height refers to the height of the lowest pods measured from the ground surface (ie. Top of ridges in the no-till treatments). Responses for crop and pod height were similar, so only pod height is presented in the tables and figures. Increased plant density generally resulted in slightly increase crop and pod heights (Table 1.5). Both crop and pod height was generally reduced by delayed sowing (Fig 1.2). However, the response was different among the different genotypes compared. In addition, crop and pod height was slightly increased in wider row spacing treatments and with standing stubble, compared with the narrow row space treatment and slashed stubble.

Similar to 2008, the tallest genotype was 01040-1057 and shortest 99226*02HS001 (Fig. 1.2). However, this data showed that sowing genotypes, such as Genesis090, early can significantly improve pod height (Fig 1.2).

Table 1.5. The effect of the interaction between sowing rate and chickpea genotype on pod height at Minyip in 2009.

| **Sowing rate (plants/m²)** | **Almaz** | **Genesis 079** | **Genesis 090** | **Genesis 509** |
|---|---|---|---|---|
| 15 | 28 | 19 | 26 | 21 |
| 30 | 29 | 22 | 29 | 22 |
| 45 | 32 | 21 | 31 | 24 |
| lsd(P<0.05)$_{PDxgenotype}$ = 1.9 | | | | |

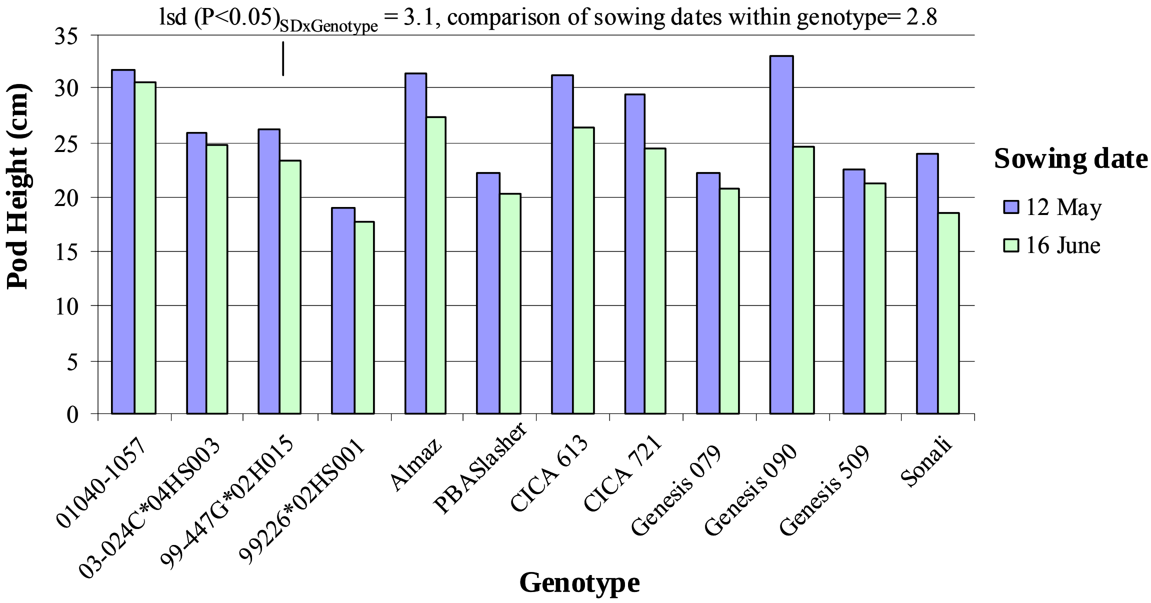


Figure 1.2. The effect of the interaction between sowing date and chickpea genotype on pod height at Minyip in 2009.

- Biomass and Grain Yield – Biomass production ranged between 2 and 4t/ha for chickpeas at Minyip. There were no significant interactions however main effects of genotype, row spacing and sowing date were all significant. Generally earlier sowing produced 25% extra biomass (Fig. 1.3) and the slashed and narrow row space (eg. sl, 0.195) treatments produced more biomass than the standing stubble and wider row space treatments (eg. ST, 0.6; Table 1.6). Genesis 090 and Almaz produced the most biomass and Sonali least (Fig. 1.3). Grain yields were relatively low considering the biomass production and ranged between 0.5 and 1.0t/ha. In general the wider row spacing treatments and standing stubble resulted in significantly higher grain yields than the slashed stubble and narrow row space treatments (Table 1.6). There was and interaction between sowing date and genotype. For most genotypes grain yield was higher when sown early (eg PBA Slasher), however for some genotypes, there was no difference in yield between the sowing dates (eg. Genesis 090; Fig. 1.3). In general, PBASlasher had the highest yields and 01040-1057 the lowest yields. Sowing rate had a significant effect with grain yields being reduced by 10% and 40% in the 30 and 15 plants/m$^2$ treatments compared with the 45 plants/m$^2$ treatment. It was also notable that biomass was not always correlated with grain yields meaning that the harvest indices varied from 0.2 to 0.3 (data not shown).

Table 1.6. The main effect row space treatment on biomass at maturity and grain yield of chickpeas at Minyip in 2009.

| Row Space | Biomass (t/ha) | Grain Yield (t/ha) |
|---|---|---|
| sl, 0.195 | 3.47 | 0.72 |
| sl, 0.3 | 3.17 | 0.73 |
| ST, 0.3 | 2.94 | 0.81 |
| ST, 0.6 | 2.93 | 0.80 |
| lsd(P<0.05) | 0.36 | 0.07 |

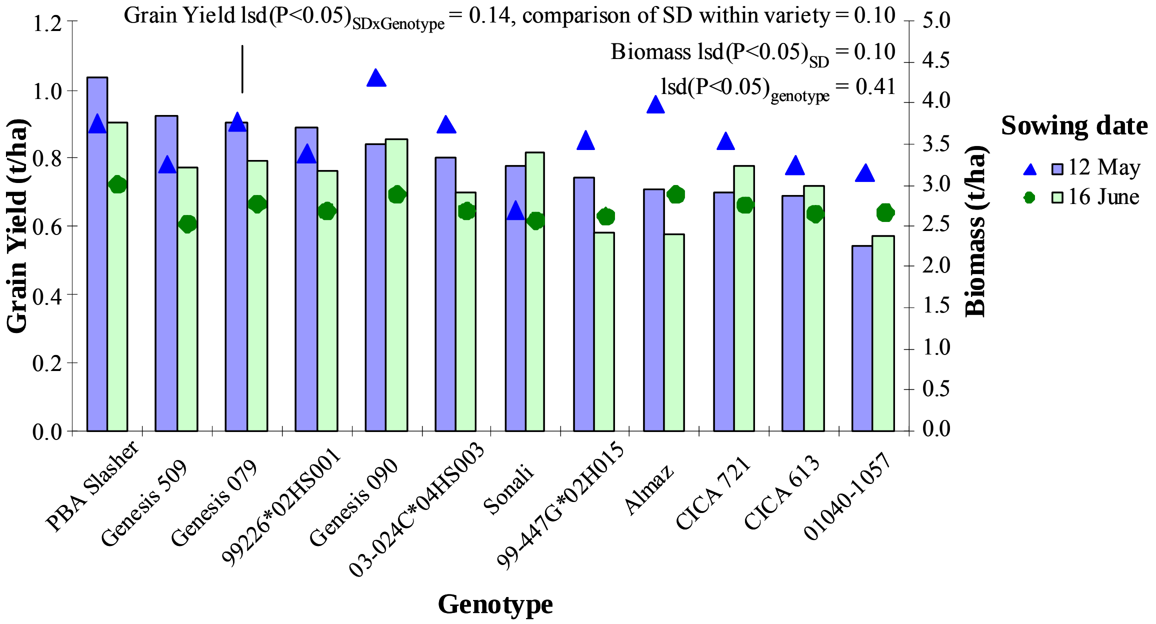


Figure 1.3. The effect of the interaction between sowing date and chickpea genotype on biomass at maturity and grain yield at Minyip in 2009 (Columns refer to grain yield and triangles and circles to biomass).

- Seed Size – Due to heat wave in early November grain weights were extremely small, generally 20-30% less than indicated in Table 1.1.

**TRIAL 1.2: Chickpea Sowing Time x Row Space x Plant Density, southern Mallee (Curyo), Victoria**

Please see notes for trial 1.1 above.

**Treatments**

- Genotypes (as per trial 1.1 above)
- Sowing Dates (5 May, 10 June)
- Plant Densities (as per trial 1.1 above)
- Row Spacings

  1. Inter-row, 30 cm row spacing, standing stubble

.... 2. Inter-row, 60 cm row spacing, standing stubble

.... 3. 19 cm row spacing, slashed stubble

**Results and Interpretation**

- Key Message: Trial not harvested in 2009 due to dry conditions and poor growth throughout the season.

## TRIAL 2.1: Lentil Sowing Time x Row Space x Plant Density, Wimmera (Minyip), Victoria

### Treatments

- Genotypes - All genotypes in Table 2.1 were used, except CIPAL702 and 99-088L*02H051.

Table 2.1 Disease and agronomic characteristics of lentil genotypes and advanced breeding genotypes used in 2009 trials.

| Name | Vigour # | Lodging Resistance# | Pod Drop # | Shattering # | Flowering Time # | Maturity | Comments |
|---|---|---|---|---|---|---|---|
| **Aldinga** | Mod | S | MR | MR | Mid | Mid | tall, primary branches |
| **Northfield** | Poor/Mod | MS | MR | MS | Mid/Late | Mid | short |
| **Nugget** | Mod | MS/MR | MR | MS | Mid | Mid/Late | semi-erect-branching |
| **Nipper** | Poor/Mod | MR | MR | MR | Mid/Late | Mid | short/erect |
| **Boomer** | Good | MS | S | MS | Mid | Late | tall/bulky |
| **PBAFlash** | Mod | MR | MR | MR | Mid | Early/Mid | erect/high pods/crop topping |
| **PBABounty** | Mod | MS | MR | MR | Mid/Late | Mid | prostrate/many branches |
| **CIPAL501** | Mod | MS | MS | MR | Mid | Mid/Late | Nugget type |
| **CIPAL605** | Mod | MS | MR | MR | Mid | Mid | Aldinga type |
| **CIPAL607** | Poor/Mod | MS | MR | MR | Mid/Late | Mid/Late | |
| **CIPAL610** | Mod/Good | MR | MR | MR | Early/Mid | Early | vigorous/early flowering |
| **CIPAL611** | Mod | MR | MR | MR | Mid/Late | Mid | |
| **CIPAL702** | Poor/Mod | MR | MR | MR | Mid/Late | Mid/Late | Herbicide tolerant |
| **CIPAL801** | Mod | R | MR | MR | Mid | Mid | erect/tall/crop topping |
| **CIPAL802** | Mod | R | MR | MR | Mid | Mid | erect/tall/crop topping |
| **CIPAL803** | Mod | MR | MR | MR | Mid | Mid | prostrate/bulky/branching |
| **CIPAL804** | Good | MS | MR | MR | Mid | Mid/Late | |
| **99-088L*02H051** | Mod | R | | MS | Mid/Early | Mid | Tall |

R = resistant, MR = moderately resistant, MS = moderately susceptible, S = susceptible; # Ratings relative to Nugget

- Sowing Dates (12 May, 16 June)
- Plant Densities (70, 110, 150 plants/m$^2$), only varieties indicated in table 2.2

Table 2.2 Seeding rate (kg/ha) required to achieve target plant densities in lentils. Seed weight (g/100 seed) indicated in brackets

| ***Plant density (plants/m$^2$)*** | **Nugget** (3.7) | **Boomer** (5.7) | **Nipper** (3.1) | **PBABounty** (3.6) |
|---|---|---|---|---|
| 70 | 27 | 42 | 23 | 26 |
| 110 | 43 | 66 | 36 | 40 |
| 150 | 58 | 90 | 49 | 55 |

- Row Spacings
  1. Inter-row, 30 cm row spacing, standing stubble (ST, 0.30)

.... 2. Inter-row, 30 cm row spacing, slashed stubble (sl, 0.30)

.... 3. 19 cm row spacing, slashed stubble (sl, 0.19)

### Results and Interpretation

- Key Message: In 2009, earlier sowing resulted in highest yield and best grain quality, particularly due to the extreme heatwave in November. There were no major differences in yield with wider row spacings (30cm c.f. 19.5cm), unlike 2007 and 2008, however standing stubble resulted in 20-100% increase in crop and pod height yield compared with slashed stubble treatments. It was notable that the highest yielding variety in these trials was PBAFlash which has slightly earlier maturity, combined with erect plant growth and high pod production.

- Climate – See Chickpeas above (Table 1.3 and Fig. 1.1)
- Plant establishment – Establishment for all lentil genotypes was 5-20% less than the target of 110 pl/$m^2$ (Table 2.3). There was significant variation among genotypes, with PBAFlash having the highest establishment and CIPAL610 and CIPAL607 lowest. Genotypes showed similar trends across the varied sowing rates with the target achieved for 70 plants/$m^2$, but 15% and 20% lower in the 110 plants/$m^2$ and 150 plants/$m^2$ treatments, respectively (data not shown).

Table 2.3. Establishment (plants/$m^2$) of lentil genotypes (target 110 pl/$m^2$) sown at Minyip in 2009 averaged across sowing dates and row spacing treatments.

| **Aldinga** | **Boomer** | **PBAFlash** | **PBABounty** | **CIPAL501** | **CIPAL605** | **CIPAL607** | **CIPAL610** |
|---|---|---|---|---|---|---|---|
| 98 | 95 | 103 | 92 | 92 | 94 | 88 | 88 |
| **CIPAL611** | **CIPAL801** | **CIPAL802** | **CIPAL803** | **CIPAL804** | **Nipper** | **Northfield** | **Nugget** |
| 92 | 91 | 96 | 89 | 98 | 94 | 94 | 94 |
| $lsd(P<0.05)_{Genotype}$ - 7 | | | | | | | |

- Crop and Pod Height – There were no effects of plant density or sowing date on crop and pod height in 2009 at Minyip. However there was a significant interaction between row space treatment and genotype (Fig. 2.1). Generally there was no difference between the slashed stubble treatments at 19cm and 30cm row spacing's, but in the standing stubble, 30cm row space treatment there was a 20-50% increase in crop height and 20%-100% increase in pod height (Fig 2.1). PBABounty had the shortest crop height and lowest pods in the wider rows (30cm) with standing stubble. CIPAL802 was tallest for crop height and Nipper had the highest pod height. Nipper and CIPAL802 also showed the least reduction in crop and pod height when stubble was slashed, demonstrating their lodging resistance (Fig. 2.1).
- Biomass and Grain Yield – Biomass production in 2009 was excellent, ranging from 3.2t/ha to 6.6t/ha (Table 2.4), due to the good winter and early spring rainfall and mild temperatures. There were no significant difference between row spacing and seeding rates, however biomass was significantly greater for treatments sown May 12 compared with those sown June 16$^{th}$. PBAFlash produced the most biomass at both sowing dates, while CIPAL605 was least at 12 May and CIPAL607 least at 16 June sown plots (Table 2.4). Potential grain yields based on a conservative harvest index of 0.3 was 1-2t/ha. However due to the heatwave in November, grain yields only achieved 0.3-1t/ha (Tables 2.5 and 2.6), with harvest indicies ranging from 0.05-0.15. Generally May 12 sown plots achieved the highest or equal highest grain yields. PBAFlash had the highest grain yield at both sowing dates (Table 2.6). The late maturing genotype CIPAL501 and green lentils, Boomer and CIPAL804 had the lowest grain yields. There were small differences between row space treatments, with the 30cm row space, slashed stubble treatment generally showing generally achieved with higher plant densities (data not shown).
- Seed Size – There were no major difference between treatments for seed size, however seed of all genotypes was very small and in many cases discoloured and shrivelled. Later maturing genotypes such as CIPAL501 were most affected.

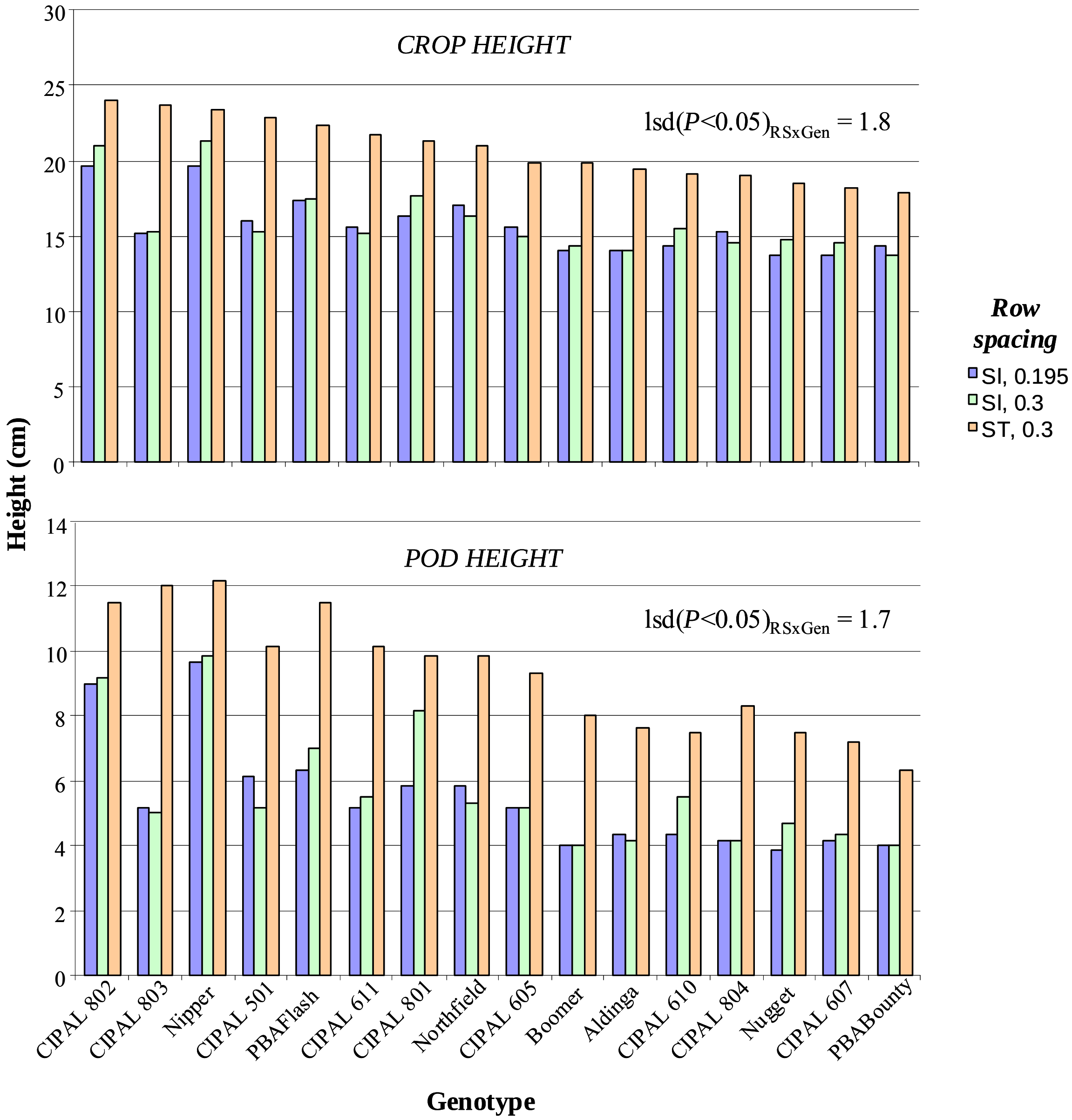


Fig 2.1. The effect of the interaction between row spacing, stubble and lentil genotype on crop and pod height (cm) at Minyip in 2009.

Table 2.4. The effect of the interaction between sowing date and lentil genotype on biomass (t/ha) at Minyip in 2009.

| Sowing Date | Aldinga | Boomer | PBAFlash | PBABounty | CIPAL 501 | CIPAL 605 | CIPAL 607 | CIPAL 610 |
|---|---|---|---|---|---|---|---|---|
| 12 May | 5.7 | 5.3 | 6.6 | 5.3 | 5.4 | 5.0 | 5.2 | 5.1 |
| 16 June | 4.3 | 4.2 | 4.7 | 3.9 | 4.5 | 4.3 | 3.2 | 4.0 |
| | **CIPAL 611** | **CIPAL 801** | **CIPAL 802** | **CIPAL 803** | **CIPAL 804** | **Nipper** | **Northfield** | **Nugget** |
| 12 May | 5.5 | 5.4 | 5.8 | 5.9 | 5.8 | 5.7 | 5.8 | 5.4 |
| 16 June | 4.3 | 4.2 | 4.5 | 4.4 | 4.5 | 4.6 | 4.3 | 4.3 |

lsd(P<0.05)SD x gen = NS; Main effect of sowing date = 0.55; genotype = 0.47.

Table 2.5. The effect of the interaction between row spacing treatment and lentil genotype on grain yield (t/ha) at Minyip in 2009.

| Row Space | Aldinga | Boomer | PBAFlash | PBABounty | CIPAL 501 | CIPAL 605 | CIPAL 607 | CIPAL 610 |
|---|---|---|---|---|---|---|---|---|
| Sl, 0.195 | 0.62 | 0.24 | 0.87 | 0.58 | 0.49 | 0.60 | 0.39 | 0.60 |
| Sl, 0.3 | 0.66 | 0.35 | 0.95 | 0.53 | 0.46 | 0.61 | 0.50 | 0.73 |
| ST, 0.3 | 0.68 | 0.35 | 0.81 | 0.65 | 0.42 | 0.66 | 0.44 | 0.69 |

| Row Space | CIPAL 611 | CIPAL 801 | CIPAL 802 | CIPAL 803 | CIPAL 804 | Nipper | Northfield | Nugget |
|---|---|---|---|---|---|---|---|---|
| Sl, 0.195 | 0.59 | 0.71 | 0.71 | 0.45 | 0.31 | 0.56 | 0.44 | 0.48 |
| Sl, 0.3 | 0.64 | 0.86 | 0.81 | 0.53 | 0.34 | 0.73 | 0.45 | 0.49 |
| ST, 0.3 | 0.54 | 0.71 | 0.70 | 0.46 | 0.33 | 0.57 | 0.42 | 0.46 |

lsd(P<0.05)RS x gen = 0.12, except when comparing row space within a genotype = 0.07

Table 2.6. The effect of the interaction between sowing date and lentil genotype on grain yield (t/ha) at Minyip in 2009.

| Sowing Date | Aldinga | Boomer | PBAFlash | PBABounty | CIPAL 501 | CIPAL 605 | CIPAL 607 | CIPAL 610 |
|---|---|---|---|---|---|---|---|---|
| 12 May | 0.73 | 0.32 | 1.05 | 0.71 | 0.48 | 0.67 | 0.51 | 0.81 |
| 16 June | 0.58 | 0.30 | 0.70 | 0.46 | 0.43 | 0.57 | 0.38 | 0.54 |

| Sowing Date | CIPAL 611 | CIPAL 801 | CIPAL 802 | CIPAL 803 | CIPAL 804 | Nipper | Northfield | Nugget |
|---|---|---|---|---|---|---|---|---|
| 12 May | 0.66 | 0.87 | 0.89 | 0.56 | 0.34 | 0.67 | 0.43 | 0.52 |
| 16 June | 0.52 | 0.65 | 0.59 | 0.40 | 0.32 | 0.58 | 0.45 | 0.43 |

lsd(P<0.05)SD x gen = 0.13, except when comparing sowing date within a genotype = 0.10

## TRIAL 2.2: Lentil Sowing Time x Row Space x Plant Density, southern Mallee (Curyo), Victoria

Please see notes for trial 2.1 above.

### Treatments

- Genotypes (as per trial 2.1 above, except 99-088L*02H051 used instead of CIPAL804)
- Sowing Dates (5 May, 10 June)
- Plant Densities (as per trial 2.1 above)
- Row Spacings
  1. Inter-row, 30 cm row spacing, standing stubble (ST, 0.30)
  2. 19 cm row spacing, slashed stubble (sl, 0.19)

### Results and Interpretation

➢ Key Message: Earlier sowing generally resulted in highest yields. Similar to Minyip ,there were no major differences in yield with wider row spacings (30cm c.f. 19.5cm). However, an increase in pod height in the wider rows and standing stubble was only recorded at the second sowing date.

- Plant establishment – Establishment for all lentil genotypes was approximately 80 plants/m$^2$ in the 110 plants/m$^2$ treatment. There was no significant variation among genotypes. Genotypes showed similar trends across the varied sowing rates with establishment 10% less for 70 plants/m$^2$, and 25% lower in the 110 plants/m$^2$ and 150 plants/m$^2$ treatments (data not shown).
- Crop and Pod Height – Only pod height is discussed here as crop and pod height were significantly correlated (r=0.9). There were no effects of plant density on pod height in 2009 at Curyo. However there was a significant interaction between sowing date and genotype, with Nugget showing almost no difference between sowing dates, while CIPAL803 and CIPAL802 showing a 4.5 – 5.2 cm improvement in pod height at the earlier sowing date (Table 2.7). There was also and interaction between sowing date and row space treatment, where on average across all varieties there was no difference between the two treatment when sown 5 May, however when sown 10 June the ST, 0.3 treatment produced pods 15% higher than the sl, 0.195 treatment (Table 2.8).

Table 2.7. The effect of the interaction between sowing date and lentil genotype on pod height (t/ha) at Curyo in 2009.

| Sowing Date | 99-088L*02H051 | Aldinga | Boomer | PBAFlash | PBABounty | CIPAL 501 | CIPAL 605 | CIPAL 607 |
|---|---|---|---|---|---|---|---|---|
| 12 May | 12.7 | 11.7 | 10.5 | 12.0 | 11.8 | 12.5 | 9.3 | 11.8 |
| 16 June | 11.0 | 10.8 | 8.8 | 10.8 | 8.8 | 10.2 | 8.8 | 9.5 |
| | **CIPAL 610** | **CIPAL 611** | **CIPAL 801** | **CIPAL 802** | **CIPAL 803** | **Nipper** | **Northfield** | **Nugget** |
| 12 May | 11.2 | 14.2 | 13.2 | 15.3 | 14.0 | 12.0 | 13.2 | 11.8 |
| 16 June | 9.0 | 12.3 | 11.8 | 10.8 | 9.8 | 10.2 | 10.8 | 11.2 |
| lsd(P<0.05)SD x gen = 0.16 | | | | | | | | |

Table 2.8. The effect of the interaction between sowing date and row space treatment on pod height (t/ha) at Curyo in 2009.

| Row Space | 5 May | 10 June |
|---|---|---|
| Sl, 0.195 | 12.3 | 9.6 |
| ST, 0.3 | 12.3 | 11.0 |

lsd(P<0.05)SD x row space = 0.08, except when comparing sowing date within a sowing date = 0.11

- Grain Yield – Due to the heatwave in November, potential grain yields were limited, however seed quality was relatively unaffected. For all genotypes, except CIPAL802, May 5 sown plots achieved the highest or equal highest grain yields (Table 2.9). The reason for the poor performance of CIPAL802 when sown early at Curyo is unclear. Similar results were observed at a breeding site in the southern Mallee, in relation to CIPAL802's ranking among other genotypes. Further investigation is required to clarify these findings. CIPAL803 was generally the highest yielding genotype and Northfield lowest. Both Nipper and Northfield were extremely sensitive to delayed sowing with a yield drop of approximately 75%, while several other genotypes including CIPAL610, CIPAL801, CIPAL611 showed no difference between sowing dates (Table 2.9). The response of genotypes across row spacing's was similar, with a trend toward higher yield in the sl,0.195 treatment when sown early, while this response was inverted at the later sowing date (Table 2.10). Increased sowing rate at the later sowing dowing date increased grain yield for all genotypes except PBABounty (Table 2.11)
- Seed Size – There were no major difference between treatments for seed size and seed of all genotypes was similar to expected.

Table 2.9. The effect of the interaction between sowing date and lentil genotype on grain yield (t/ha) at Curyo in 2009.

| Sowing Date | 99-088L*02H051 | Aldinga | Boomer | PBAFlash | PBABounty | CIPAL 501 | CIPAL 605 | CIPAL 607 |
|---|---|---|---|---|---|---|---|---|
| 12 May | 0.59 | 0.68 | 0.67 | 0.56 | 0.82 | 0.82 | 0.86 | 0.66 |
| 16 June | 0.63 | 0.32 | 0.39 | 0.46 | 0.51 | 0.44 | 0.43 | 0.46 |
| | **CIPAL 610** | **CIPAL 611** | **CIPAL 801** | **CIPAL 802** | **CIPAL 803** | **Nipper** | **Northfield** | **Nugget** |
| 12 May | 0.58 | 0.59 | 0.64 | 0.47 | 0.83 | 0.59 | 0.55 | 0.58 |
| 16 June | 0.61 | 0.56 | 0.59 | 0.68 | 0.64 | 0.15 | 0.15 | 0.43 |
| lsd(P<0.05)SD x gen = 0.13 | | | | | | | | |

Table 2.10. The effect of the interaction between sowing date and row space treatment on grain yield (t/ha) at Curyo in 2009.

| Row Space | 5 May | 10 June |
|---|---|---|
| Sl, 0.195 | 0.69 | 0.43 |
| ST, 0.3 | 0.62 | 0.50 |

lsd(P<0.05)SD x row space = 0.08, except when comparing sowing date within a sowing date = 0.12

Table 2.11. The effect of the interaction between sowing date, sowing rate and genotype on grain yield (t/ha) at Curyo in 2009

| Sowing Date | Sowing Rate ($pl/m^2$) | Boomer | PBABounty | Nipper | Nugget |
|---|---|---|---|---|---|
| 5 May | 70 | 0.57 | 0.82 | 0.63 | 0.62 |
| | 110 | 0.67 | 0.82 | 0.59 | 0.58 |
| | 150 | 0.53 | 0.76 | 0.53 | 0.64 |
| 10 June | 70 | 0.23 | 0.49 | 0.13 | 0.36 |
| | 110 | 0.39 | 0.51 | 0.15 | 0.43 |
| | 150 | 0.49 | 0.59 | 0.27 | 0.54 |

lsd(P<0.05)TOSxSD x genotype = 0.12

## 2. Sowing time by Blackspot in Peas

*Aim:* To assess wether recent field pea breeding advancements in resistance to blackspot are significant enough to allow management changes to sowing time in this crop.
The ability to successfully sow field peas earlier in low and medium rainfall environments will maximise grain yield and crop reliability in these environments. Information will also be provided to PBA Field peas on the disease resistance level required to bring forward field pea sowing dates in low and medium rainfall environments. This experiment will occur for 1 more year depending upon germplasm availability from PBA Field peas.

*Treatments*

**Table 1:** Disease treatments at Hart and Turretfield, 2009

| Site | Turretfield (High rainfall) | Hart (medium rainfall) |
|---|---|---|
| Pea rotation | > 4 years | 3 years |
| Cultivars | Kaspa, Alma, OZP0602, OZP0601 | Kaspa, Alma, OZP0602, OZP0601 |
| Sowing dates | May 11, June 1, June 19 | April 30, May 18, June 4 |
| Fungicide treatments | 1. Nil | 1. Nil |
| | 2. PPT + Mancozeb | 2. PPT + Mancozeb |
| | 3. Mancozeb @ 4 node & early flower | 3. Mancozeb @ 6 node & early flower |
| | 4. Mancozeb @ 9 node & early flower | 4. Mancozeb @ 9 node & early flower |
| | 5. PPT + Manc. @ 9 node & early flower | 5. PPT + Manc. @ 9 node & early flow. |
| | 6. Fortnightly Chlorothalonil | 6. Fortnightly Chlorothalonil |
| Blackspot level | high | high |
| Site mean grain yield (t/ha) | 2.67 | 2.43 |

Measurements: Disease levels, grain yield and grain weight.

**Note: trials on sowing time by Alma and Kaspa varieties were funded by SA Grains Industry Trust as part of a separate project in SA validating disease forecasting models. Funds from this GRDC project allowed the incorporation of OZP0601 and OZP0602 into these experiments to evaluate the potential benefits of improved blackspot resistance in field peas.**

### Results and Interpretation

The early break to the season allowed timely sowing of trials. High levels of early foliar disease (blackspot) infection occurred (Table 2). Significant and frequent rainfall events in spring favoured disease progression and foliar fungicide treatments reduced disease levels to varying extents at both sites (Table 2). Despite the rapid and sudden heat induced finish to the season in early November disease infections reduced grain yields at both sites last year (Table 3), unlike in 2007 & 2008.

**Table 2:** Effect of sowing date and cultivar on blackspot disease severity and grain yield at two sites in SA, 2009.

| | | Foliar blackspot % plot severity | | | | | Grain yield (t/ha) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **Sow date** | **Alma** | **Kaspa** | **OZP 0601** | **OZP 0602** | **Mean** | **Alma** | **Kaspa** | **OZP 0601** | **OZP 0602** | **Mean** |
| **Hart** | **May 1** | 6.8 | 5.8 | 5.0 | 3.2 | 5.2 | 1.41 | 2.24 | 2.06 | 2.08 | 1.95 |
| | **May 21** | 2.3 | 1.1 | 0.8 | 0.6 | 1.2 | 2.12 | 2.93 | 2.88 | 3.09 | 2.75 |
| **Rated** | **June 8** | 0.7 | 0.1 | 0.2 | 0.1 | 0.3 | 1.53 | 2.76 | 2.97 | 3.1 | 2.59 |
| **23/7** | **Mean** | 3.3 | 2.4 | 2.0 | 1.3 | | 1.69 | 2.64 | 2.64 | 2.75 | |
| | | lsd (P<0.05) = 1.7 (1.8 same sow date) | | | | | lsd (P<0.05) = 0.30 (0.15 same sow date) | | | | |
| | | | | | | | | | | | |
| **T/field** | **May 9** | 13.0 | 11.1 | 11.1 | 10.5 | 11.4 | 2.09 | 2.92 | 2.87 | 3.17 | 2.76 |
| | **May 30** | 5.1 | 4.7 | 4.4 | 3.9 | 4.5 | 1.71 | 2.95 | 3.15 | 3.09 | 2.72 |
| **Rated** | **June 20** | 2.8 | 2.2 | 2.1 | 2.2 | 2.3 | 1.53 | 2.66 | 3.04 | 2.94 | 2.54 |
| **9/9** | **Mean** | 7.0 | 6.0 | 5.8 | 5.5 | | 1.78 | 2.84 | 3.02 | 3.06 | |
| | | lsd (P<0.05) = 1.3 (0.9 same sow date) | | | | | lsd (P<0.05) = 0.16 (0.11 same sow date) | | | | |

The field peas were severely affected by blackspot, especially at the earliest sowing time. Over the three years these trials have been run, the two earlier sowings have generally been equal or higher yielding than sowing in early June. However at Hart in 2009, the yield of all varieties in the earliest sowing period were 25-30% below the second two sowing periods due to severe blackspot, clearly demonstrating the disease risk associated with early sowing (on the season break) of field peas. Despite significant disease infection levels at Turretfield, the later sowing dates only yielded similarly to the earlier sowing date as they were more adversely affected by the November heat wave than at Hart.

The advanced Pulse Breeding Australia field pea line OZP0602 was higher yielding than Kaspa, particularly at the later two sowing times of mid-May and early June (Table 2). However the benefit of the new line over Kaspa was lost in the earliest sowing treatment at Hart under severe blackspot. The old conventional cultivar Alma was lowest yielding particularly under high disease pressure. Fungicide applications found that the combination of P-Pickel T® seed treatment with two sprays of mancozeb (at 9 nodes and again at early flowering) were economic in some instances at Hart in 2009. Yield gains of 0 – 27% over the untreated plots were achieved dependent upon sowing date and variety (Table 3). Generally Alma had higher levels of foliar disease and higher levels of percentage yield gain from the fungicide treatments. Percentage yield gains in Kaspa and OZP0602 ranged from 7 -14% and these varieties performed similarly in relation to disease infection level and response to foliar fungicide treatments last year. Without the seed dressing, yield gains from two sprays of mancozeb, were generally less and more variable ranging from 0-14%. However timing of sprays relative to rainfall events and varietal flowering commencement appeared critical to yield response, such that fungicide sprays should be applied prior to significant rainfall events and earlier in OZP0602 than Kaspa, due to its earlier flowering date.

The above yields gains from the fungicides treatment strategies were still a lot less than those achieved by the fortnightly spraying treatment (19-65%) (Table 3). This treatment is uneconomical but does indicate that there are still yield gains to be made by controlling blackspot either through improved fungicides or increased genetic resistance.

**Table 3:** Effect of sowing date and fungicide treatment on disease severity of field peas at Hart and Turretfield, SA, 2009

| Treatment | Foliar blackspot % plot severity | | | | | |
|---|---|---|---|---|---|---|
| | Turretfield (rated 24/9/2009) | | | Hart (rated 15/9/2009) | | |
| | May 9 | May 30 | June 20 | May 1 | May 21 | June 8 |
| **Nil** | 16.7 | 10.0 | 6.0 | 16.5 | 7.8 | 3.9 |
| **Mancozeb @ 4 node + early flowering** | 15.2 | 10.1 | 5.5 | 15.6 | 7.5 | 3.6 |
| **Mancozeb @ 9 node + early flowering** | 15.6 | 10.0 | 4.8 | 15.3 | 6.4 | 3.8 |
| **PPT + Mancozeb @ 9 node** | 15.7 | 9.0 | 4.0 | 15.8 | 7.7 | 3.5 |
| **PPT + Mancozeb @ 9 node + early flowering** | 15.8 | 9.0 | 4.7 | 14.5 | 6.0 | 3.0 |
| **Fortnightly chlorothalonil** | 9.0 | 3.3 | 1.1 | 4.4 | 1.7 | 0.6 |
| **LSD (P<0.05)** | 1.4 (1.4 same sow date) | | | 1.1 (1.1 same sow date) | | |

## Key findings & comments

- Grain yields of field peas sown at Hart on the season break in 2009 were heavily infected with blackspot and reduced by 30% (0.8 t/ha) compared with later sowing times.
- Early sowing of field pea is often essential for economic yields in dry years in low rainfall environments, however frost, weed and blackspot risks must be known and best practice management strategies implemented where possible.
- Sowing peas two to four weeks earlier (late May) than the conventional time (early –mid June) optimises production of Kaspa and the early, longer flowering line OZP0602.
- OZP0602 was generally higher yielding than Kaspa particularly in later sowing treatments. It was not as dependent as Kaspa on early sowing for maximum grain yield and therefore will provide an option for blackspot management in lower rainfall shorter growing season environments.
- Yield loss from blackspot can be minimised if peas are sown after 60% of airborne spores have been released.
- The combination of P-Pickel T with two sprays of mancozeb was economic in the time of sowing trial at Hart in 2009, resulting in on average a 7-14% yield gain in Kaspa and OZP0602.
- Timing of foliar fungicide sprays relative to rainfall events and varietal flowering appears critical to yield response.
- Fortnightly sprays show more yield gains are possible, either through improved fungicides or increased genetic resistance.

## Acknowledgments

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## 3. Crop-topping or desiccation effects on weed control and seed quality

*Aim:* To determine the correct maturity timing required in field peas, chickpeas, lentils and faba beans for successful crop topping practice.

The ability to crop top pulses without incurring grain yield loss will improve management options for controlling resistant ryegrass in many cropping areas of southern Australian. Early harvest will also allow farmers to spread their harvest operation and allow more efficient use of machinery. Furthermore, harvesting at the optimum time improves seed quality and reduces weather damage and soil contamination, thereby minimising or eliminating down grading of seed quality and maximising the marketability of the crop.
Information will be provided to PBA on the maturity timing of genotypes to optimise control of ryegrass and maximise yield and seed quality.

Treatment timing:
Nil - no desiccant applied
Early Crop-top - applied 7-14 days pre ryegrass milky dough stage (see tables for dates)
Mid Crop-top - applied at ryegrass milky dough stage (“Recommended”- see tables for dates)
Late Crop-top - applied 7-14 days post ryegrass milky dough stage (see tables for dates)

Chemical used: Paraquat 250 @800ml /ha

Sow dates: Peas: Balaklava 26/5/09, Turretfield 5/6/09; Lentils & Chickpeas: 29/5/09; Beans: 14/5/09

Fertiliser: MAP @ 80 -100 kg/ha + 2% Zinc drilled with the seed.

**Table 1.** Flowering and maturity characteristics of pulse varieties evaluated in crop topping genotype by management trials, SA 2009.

| Peas | Flow. | Mat. | Lentils | Flow. | Mat. | Chickpeas | Flow. | Mat. | Beans | Flow. | Mat. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Alma** | L | L | **Aldinga** | M | M | **Almaz** | M-L | M-L | **Doza** | E | E |
| **Bundi** | E | E | **Boomer** | E-M | M-L | **Genesis079** | E | E | **Fiord** | E-M | E |
| **Dundale** | E | M | **Cumra** | E-M | E | **Genesis090** | M | M | **Fiesta** | E-M | E-M |
| **Glenroy** | L | L | **Nipper** | M-L | M | **Genesis114** | M-L | M-L | **Farah** | E-M | E-M |
| **Kaspa** | L | M | **Northfield** | M-L | M | **Genesis509** | E-M | E-M | **Manafest** | L | M |
| **Parafield** | M-L | M | **Nugget** | M | M-L | **Howzat** | M | M | **Nura** | M-L | E-M |
| **Sturt** | M | M-L | **PBA Flash** | M | E-M | **PBA Slasher** | M | M | **AF03001** | E | E |
| **SWCeline** | E | VE | **PBA Bounty** | M-L | M | **Sonali** | E | E | **AF03063** | E | E-M |
| **Yarrum** | L | M | **CIPAL501** | M | M-L | **CICA0512** | M | M | **AF04085** | E-M | M |
| **OZP0601** | E | E | **CIPAL605** | M | M | **CICA0603** | E-M | E-M | **IX101/1-55** | E | E |
| **OZP0602** | E | E | **CIPAL607** | M-L | M-L | **CICA0604** | M | M | **974*(611*974)/15-1** | M-L | M-L |
| **OZP0703** | M | E | **CIPAL610** | E-M | E | **CICA0717** | M | M | **1269*483/6-1** | E-M | L |
| **OZP0804** | L | M | **CIPAL611** | M-L | M | **01-481*03HS010** | VE | E | | | |
| **OZP0805** | L | E-M | **CIPAL801** | E-M | M | **01-482*03HS009** | VE | E | | | |
| **PSL-RESEL** | VE | VE | **CIPAL802** | E-M | E-M | **02-150C*04HS003** | E-M | M | | | |
| **94-425*2b** | VL | VL | **CIPAL804** | E-M | M-L | **03-028C*04HS004** | E-M | M | | | |

Flow. = flowering timing; Mat. = maturity timing; E = early; M = Mid; L = late; V = very.

## Results

*Field pea*

A significant interaction occurred between crop topping treatment and variety in both field pea experiments. Crop-topping at the recommended timing generally had no significant effect on yield or grain weight at either site compared with the nil treatment (Table 2). Turretfield, which is normally later maturing than Balaklava, suffered from very low spring rainfall in 2009, and consequently grain yields were lower at this site. Only two treatments were applied at this site due to the exceptionally rapid finish.

At Balaklava only the very late maturing forage pea line 94-425*2b showed a yield loss from the recommended crop-top timing, and also showed reduction in grain weight together with Alma (shaded lines – Table 2). All varieties showed yield losses and grain weight reductions at the early timing, and OZP0601 surprisingly showed a 12% yield loss at the late timing. The forage pea line 94-425*2b showed an increase in grain weight at the early crop-top timing at Balaklava. Seed that was set at this timing was likely from early maturing plants and therefore relatively large seeded. At subsequent crop-top timings the number of these larger seeds was diluted by an increase in the number of smaller seeds and no increase in grain weight was observed compared to the nil (Table 2).

At Turretfield, OZP0602 and Yarrum showed yield increases from the recommended crop-top timing compared to the nil, and were the only varieties to show no yield loss from early crop-topping (Table 3). This may be a result of low yields at the nil timing. OZP0805 showed a 12% yield loss at the recommended crop-top timing. The recommended timing had no influence on grain weight. At the early timing Alma, Dundale, Parafield, Sturt and the forage pea line 94-425*2b showed no difference in grain weight to the nil treatment.

**Table 2.** Effect of crop topping timing on grain yield and grain weight of field peas, Balaklava 2009

| Treatment | Yield (t/ha) | Yield (% of Nil) | | | Grain Wt. (g/100) | Grain Weight (% of Nil) | | |
|---|---|---|---|---|---|---|---|---|
| **Variety** | **Nil** | **- 2 wks[a] (7/10)** | **Recommended (23/10)** | **+ 2 wks[b] (6/11)** | **Nil** | **- 2 wks[a] (7/10)** | **Recommended (23/10)** | **+ 2 wks[b] (6/11)** |
| **Alma** | 1.90 | 57 | 93 | 94 | 15.3 | 68 | 89 | 99 |
| **Bundi** | 2.31 | 60 | 97 | 95 | 18.2 | 64 | 103 | 94 |
| **Dundale** | 1.94 | 57 | 97 | 94 | 16.3 | 67 | 99 | 98 |
| **94-425*2b** | 0.57 | 16 | 19 | 73 | 8.8 | 159 | 74 | 86 |
| **Glenroy** | 2.11 | 35 | 93 | 91 | 12.4 | 68 | 108 | 102 |
| **Kaspa** | 2.79 | 38 | 83 | 98 | 15.9 | 60 | 94 | 102 |
| **OZP0601** | 2.38 | 58 | 94 | 88 | 16.2 | 63 | 94 | 98 |
| **OZP0602** | 2.72 | 57 | 100 | 96 | 18.8 | 60 | 95 | 102 |
| **OZP0703** | 2.95 | 61 | 95 | 93 | 20.2 | 68 | 99 | 95 |
| **OZP0804** | 2.70 | 49 | 92 | 95 | 13.3 | 54 | 94 | 100 |
| **OZP0805** | 2.85 | 59 | 92 | 92 | 18.2 | 63 | 98 | 102 |
| **Parafield** | 2.41 | 53 | 93 | 98 | 15.0 | 68 | 99 | 99 |
| **PSL-RESEL** | 1.92 | 71 | 102 | 101 | 16.9 | 83 | 101 | 100 |
| **Sturt** | 2.27 | 66 | 100 | 107 | 16.0 | 67 | 94 | 97 |
| **SWCeline** | 2.42 | 65 | 93 | 90 | 18.9 | 71 | 100 | 103 |
| **Yarrum** | 2.62 | 57 | 104 | 108 | 17.9 | 59 | 94 | 98 |
| **Mean (t/ha)** | 2.30 | 1.28 | 2.16 | 2.20 | 16.1 | 11.1 | 15.6 | 15.9 |

NB: Shading denotes significant difference from the Nil treatment.

[a] = 2 weeks prior to recommended timing

[b] = 2 weeks after recommended timing

**Table 3.** Effect of crop topping timing on grain yield and grain weight of field peas, Turretfield 2009

| Treatment | Yield (t/ha) | Yield (% of Nil) | | Grain Weight (g/100) | Grain Weight (% of Nil) | |
|---|---|---|---|---|---|---|
| Variety | Nil | - 2 wks (23/10) | Recommended (6/11) | Nil | - 2 wks (23/10) | Recommended (6/11) |
| **Alma** | 1.57 | 63 | 109 | 11.7 | 83 | 109 |
| **Bundi** | 2.33 | 74 | 103 | 15.4 | 81 | 99 |
| **Dundale** | 1.89 | 68 | 110 | 14.3 | 88 | 95 |
| **94-425*2b** | 0.44 | 23 | 73 | 10.6 | 86 | 92 |
| **Glenroy** | 1.76 | 55 | 101 | 11.7 | 81 | 97 |
| **Kaspa** | 2.34 | 74 | 96 | 14.5 | 83 | 98 |
| **OZP0601** | 2.33 | 80 | 97 | 14.4 | 77 | 102 |
| **OZP0602** | 2.30 | 87 | 120 | 15.9 | 82 | 99 |
| **OZP0703** | 2.87 | 77 | 92 | 17.3 | 82 | 95 |
| **OZP0804** | 2.40 | 61 | 102 | 13.3 | 65 | 92 |
| **OZP0805** | 3.50 | 74 | 88 | 18.8 | 80 | 95 |
| **Parafield** | 2.29 | 79 | 111 | 14.0 | 86 | 88 |
| **PSL-RESEL** | 1.96 | 80 | 105 | 16.5 | 86 | 99 |
| **Sturt** | 2.47 | 77 | 102 | 12.6 | 101 | 104 |
| **SWCeline** | 2.45 | 82 | 101 | 18.6 | 86 | 100 |
| **Yarrum** | 2.50 | 87 | 122 | 17.0 | 73 | 102 |
| **Mean (t/ha)** | 2.21 | 1.65 | 2.27 | 14.8 | 12.2 | 14.5 |

NB: Shading denotes significant difference from the Nil treatment.

*Lentil*

Crop-topping of lentils at the early and recommended timings generally resulted in yield loss in 2009 (Table 4). Crop-topping at the recommended timing produced a 15% yield loss across all varieties compared to the nil, but this did not generally result in grain weight reduction. CIPAL lines 501, 605 and 804 were the only lines not to record a yield loss at this timing, and a number of other lines were only marginally behind e.g. Aldinga, PBAFlash and CIPAL lines 607, 610, 611, 801 and 802. All varieties showed a yield penalty from the early crop-top timing, but at the late timing Boomer showed a yield loss and CIPAL501 showed increased yield. The early maturing lines Cumra and CIPAL610 showed a reduction in grain weight from the early timing, while Northfield and the breeders line CIPAL804 showed an increase in grain weight from this timing. CIPAL415 and Nugget showed reduced grain weight at the recommended timing compared to the nil, and Boomer and CIPAL415 showed reduced grain weight at the late timing.

**Table 4.** Effect of crop topping timing on grain yield and grain weight of lentils, Melton 2009

| Treatment | Yield (t/ha) | Yield (% of Nil) | | | Grain Weight (g/100) | Grain Weight (% of Nil) | | |
|---|---|---|---|---|---|---|---|---|
| Variety | Nil | - 3 wks (9/10) | Recommended (30/10) | + 2 wks (12/11) | Nil | - 2 wks (7/10) | Recommended (23/10) | + 2 wks (6/11) |
| Aldinga | 3.50 | 24 | 86 | 106 | 4.3 | 106 | 93 | 98 |
| Boomer | 3.35 | 42 | 76 | 84 | 5.6 | 103 | 95 | 91 |
| PBA Flash | 3.88 | 30 | 86 | 102 | 4.2 | 100 | 95 | 101 |
| CIPAL415 | 3.05 | 38 | 77 | 98 | 3.3 | 92 | 85 | 88 |
| CIPAL501 | 3.26 | 36 | 91 | 117 | 4.1 | 102 | 95 | 100 |
| CIPAL605 | 4.00 | 36 | 92 | 98 | 4.0 | 102 | 96 | 100 |
| CIPAL607 | 2.90 | 34 | 87 | 102 | 2.7 | 105 | 91 | 95 |
| CIPAL610 | 4.07 | 28 | 90 | 102 | 5.3 | 83 | 97 | 99 |
| CIPAL611 | 3.38 | 31 | 88 | 93 | 3.8 | 108 | 91 | 97 |
| CIPAL801 | 3.58 | 36 | 86 | 96 | 3.6 | 99 | 93 | 101 |
| CIPAL802 | 4.10 | 39 | 86 | 97 | 3.9 | 92 | 93 | 96 |
| CIPAL804 | 2.84 | 52 | 90 | 101 | 4.9 | 109 | 100 | 99 |
| Cumra | 3.09 | 32 | 80 | 97 | 4.5 | 88 | 92 | 96 |
| Nipper | 2.94 | 44 | 80 | 91 | 2.5 | 105 | 96 | 95 |
| Northfield | 2.58 | 51 | 84 | 106 | 2.4 | 117 | 96 | 98 |
| Nugget | 3.20 | 31 | 82 | 93 | 3.4 | 104 | 86 | 97 |
| Mean (t/ha) | 3.36 | 1.21 | 2.87 | 3.32 | 3.9 | 3.9 | 3.7 | 3.8 |

NB: Shading denotes significant difference from the Nil treatment.

*Beans*

There was generally no yield loss at the recommended crop-top timing, but there was an average 9% reduction in grain weight across all varieties at this timing (Table 5). Manafest was the only variety to show a yield loss at this timing, while the early maturing breeders line AFO3001 was the only line not to show reduced grain weight. The early crop-top timing was 39% lower yielding than the nil treatment across all varieties, with an average 17% reduction in grain weight. At this timing only AFO3001 did not show a yield loss, and all varieties showed reduced grain weight. There was generally no reduction in yield or grain weight at the late timing.

**Table 5.** Effect of crop topping timing on grain yield and grain weight of Faba beans, Cockaleechie 2009

| Treatment | Yield (t/ha) | Yield (% of Nil) | | | Grain Weight (g/100) | Grain Weight (% of Nil) | | |
|---|---|---|---|---|---|---|---|---|
| Variety | Nil | - 2 wks (8/10) | Recommended (19/10) | + 2 wks (2/11) | Nil | - 2 wks (8/10) | Recommended (19/10) | + 2 wks (2/11) |
| 1269*483/6-1 | 1.39 | 64 | 98 | 94 | 81.0 | 87 | 91 | 100 |
| 974*(611*974)/15-1 | 1.56 | 49 | 84 | 92 | 83.9 | 83 | 89 | 99 |
| AF03001 | 1.14 | 73 | 87 | 107 | 62.3 | 80 | 96 | 103 |
| AF03063 | 1.39 | 61 | 90 | 98 | 75.8 | 82 | 94 | 101 |
| AF04085 | 1.30 | 53 | 82 | 81 | 62.1 | 85 | 88 | 99 |
| Doza | 1.19 | 67 | 89 | 102 | 56.0 | 85 | 92 | 103 |
| Farah | 1.22 | 63 | 92 | 79 | 65.8 | 88 | 92 | 99 |
| Fiesta | 1.46 | 51 | 84 | 101 | 65.1 | 84 | 90 | 103 |
| Fiord | 1.18 | 67 | 80 | 103 | 52.3 | 73 | 87 | 101 |
| IX101/1-55 | 1.24 | 66 | 74 | 71 | 65.6 | 74 | 85 | 94 |
| Manafest | 1.48 | 58 | 73 | 79 | 84.5 | 90 | 90 | 101 |
| Nura | 1.43 | 56 | 87 | 96 | 63.3 | 86 | 91 | 99 |
| Mean (t/ha) | 1.33 | 0.80 | 1.13 | 1.22 | 68.1 | 56.8 | 61.7 | 68.2 |

NB: Shading denotes significant difference from the Nil treatment.

*Chickpea*

Yield losses were high in all chickpea varieties, averaging 21% reduction in grain yield across all varieties at the recommended crop-top timing (Table 6). A 15% reduction in grain weight also took place at this timing. All varieties except for the late maturing varieties Almaz and Genesis™114 showed yield losses at the recommended timing. This is likely due to their very low grain yield at the nil timing also, caused by the rapid finish to the season. These same varieties showed the highest percentage yield loss at the early timing, which is attributable to their very late maturity. The early maturing lines 01-481*03HS010 and 01-482*03HS009, and the breeders lines CICA512, CICA604 and CICA717 also showed a significant reduction in grain weight at the recommended timing. These first three lines also showed grain weight reductions at the early timing, together with Genesis™090 and Genesis™509. There were no losses in yield or grain weight caused by the late crop-top timing.

**Table 6.** Effect of crop topping timing on grain yield and grain weight of chickpeas, Melton 2009

| Treatment | Yield (t/ha) | Yield (% of Nil) | | | Grain Weight (g/100) | Grain Weight (% of Nil) | | |
|---|---|---|---|---|---|---|---|---|
| | Nil | - 3 wks (9/10) | Recommended (30/10) | + 2 wks (12/11) | Nil | - 2 wks (7/10) | Recommended (23/10) | + 2 wks (6/11) |
| 01-481*03HS010 | 2.73 | 33 | 77 | 102 | 22.19 | 53 | 75 | 90 |
| 01-482*03HS009 | 2.27 | 48 | 86 | 103 | 21.27 | 71 | 68 | 86 |
| 02-150C*04HS003 | 1.87 | 35 | 83 | 105 | 16.03 | 97 | 83 | 100 |
| 03-028C*04HS004 | 2.12 | 23 | 74 | 97 | 16.69 | 88 | 81 | 109 |
| Almaz | 1.18 | 19 | 83 | 92 | 27.42 | 91 | 92 | 91 |
| PBA Slasher | 1.96 | 30 | 70 | 99 | 15.5 | 87 | 84 | 100 |
| CICA0512 | 1.37 | 23 | 69 | 85 | 18.05 | 77 | 81 | 93 |
| CICA0603 | 2.33 | 31 | 74 | 100 | 18.12 | 97 | 80 | 93 |
| CICA0604 | 2.28 | 25 | 69 | 102 | 16.04 | 87 | 78 | 97 |
| CICA0717 | 2.02 | 36 | 81 | 105 | 19.54 | 92 | 82 | 100 |
| Genesis079 | 2.09 | 25 | 80 | 107 | 17.96 | 95 | 104 | 104 |
| Genesis090 | 1.43 | 25 | 84 | 97 | 22.14 | 79 | 93 | 93 |
| Genesis114 | 0.90 | 17 | 86 | 114 | 22.08 | 96 | 102 | 104 |
| Genesis509 | 1.98 | 32 | 71 | 96 | 13.57 | 129 | 101 | 94 |
| Howzat | 1.70 | 21 | 72 | 94 | 16.56 | 87 | 87 | 117 |
| Sonali | 2.13 | 40 | 77 | 104 | 14.50 | 98 | 80 | 101 |
| Mean (t/ha) | 1.90 | 0.6 | 1.5 | 1.90 | 18.60 | 16.3 | 15.9 | 18.2 |

NB: Shading denotes significant difference from the Nil treatment.

## Key findings & comments

- The dry and hot November in 2009 led to early senescence of pulse varieties and reduced grain yields in later maturing varieties. Many responses to the crop-topping treatments may have been masked by this rapid senescence eg Almaz and Genesis™114 chickpeas.
- Some surprising results were observed in 2009, which may be due to either genetic responses or responses to rapid finish to the season eg forage pea grain weights.
- Field peas and Faba beans generally showed no yield loss at the recommended timing for crop-topping of ryegrass in 2009. Lentils and chickpeas showed significantly higher yield losses from crop-topping, averaging 15 and 21% yield losses respectively at this timing.
- The large biomass, mid-late maturing lentil Boomer also showed a yield loss when crop-topped later than recommended for ryegrass control. These results indicate poor suitability of some lines to this agronomic practice.
- Early maturing lentil and chickpea lines showed yield losses from this practice at the recommended timing. This demonstrates the difficulty in employing this weed control technique in these crop types.

- The early crop topping treatment reduced grain yields of most pulse varieties. Field peas OZP0602 and Yarrum at Turretfield, and the Faba bean AFO3001 showed no difference in grain yield at the early cop-top timing and the nil, indicating good suitability to this practice.
- Further work in a longer spring is required to validate these results.

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## 4. Weed Competition in chickpeas

*Aim: To determine whether varietal differences in chickpea plant architecture affect their competitiveness with ryegrass.*

Preventing increases in resistant rye grass numbers during the chickpea phase of rotations is essential for maximum crop yield and sustainable cropping systems in southern Australia. Information will also be provided to PBA Chickpeas on the chickpea plant type required to maximise this crops competitiveness with rye grass.

Site: Hart (Mid North, SA) & Turretfield (Lower North, SA)

Varieties: Includes varieties with a range of growth habits and maturities, as well as a number of advanced breeding lines suitable for evaluation (see Table 1)

Treatments (3):
1. Nil ryegrass (no rye grass sown)
2. Low ryegrass density (sown with rye grass (SLR4 Biotype 4) at 40 plants/$m^2$)
3. High ryegrass density (sown with rye grass (SLR4 Biotype 4) at 200 plants/$m^2$)

Measurements: Grain yield, grain weight, and initial and final ryegrass numbers

**Table 1:** Attributes of chickpea varieties included in this trial

| | Variety | Early Growth Habit [a] | Early Vigour | Canopy Density [b] | Height | Maturity |
|---|---|---|---|---|---|---|
| Kabuli | Almaz | semi-erect | poor | medium | medium | late |
| | Genesis™ 079 | semi-erect | moderate | medium | short | early |
| | Genesis™ 090 | semi-erect | good | dense | medium | mid |
| Desi | Genesis™ 509 | semi-erect | moderate | thin | medium | mid |
| | PBA Slasher⊕ | semi-spread | moderate | medium-thin | medium | mid |
| | Sonali | semi-erect | good | medium | tall | early |
| | Chickpea 1 [c] | semi-erect | very good | dense | very tall | mid-late |
| | Chickpea 2 [c] | erect | good | very dense | tall | mid |
| | Chickpea 3 [c] | semi-erect | moderate | dense | medium | mid |
| | Chickpea 4 [c] | erect | very good | very thin | medium | mid |

[a] Early growth habit refers to the initial branching angle, where spread denotes prostrate branching and erect denotes upright branching.

[b] Canopy density refers to the density of the mature canopy, and is important in preventing light penetration.

[c] Denotes Pulse Breeding Australia advanced chickpea line.

*Grain Yield*

Grain yields at Hart in 2009 were significantly higher than previous years, with weed free control plots averaging 1.34t/ha compared with just 0.54t/ha in 2008, and 0.87t/ha in 2007. The rapid finish to the 2009 season favoured the earlier maturing varieties Genesis™079 and Sonali (Figure 1a), which recorded more than double the yield of late maturing varieties e.g. Almaz. Trends observed at Hart were supported by a similar trial at Turretfield (Figure 1b), however grain yields were much lower (nil treatments averaging 0.57t/ha) due to extreme high temperatures during early pod fill at this site.

All lines at both sites generally decreased in yield as ryegrass density increased, although Chickpea 4 at low ryegrass density yielded similarly to the nil, and Chickpeas 1 and 2 showed little difference in yield at low and high ryegrass densities. Genesis™079 and Sonali in the absence of ryegrass were the highest yielding varieties at Hart, followed by new release PBA Slasher⊕ and chickpea breeder's lines 3 and 4 (at Turretfield these lines all yielded similarly and higher than other lines). In competition with ryegrass the same varieties were generally still higher yielding although CICA0512 also performed similarly to this group.

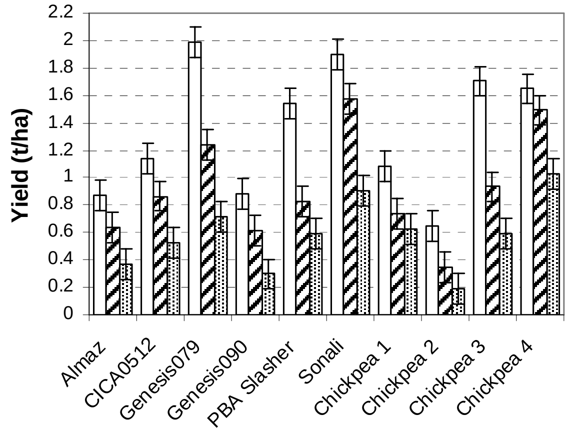


**Figure 1a:** Effect of ryegrass density on the yield of 10 chickpea lines, Hart 2009

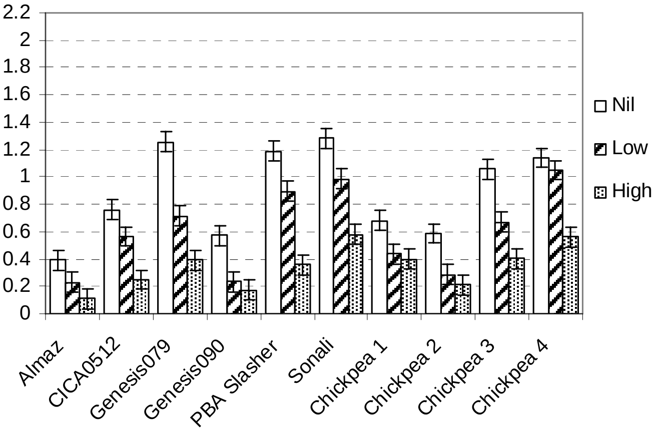


**Figure 1b:** Effect of ryegrass density on the yield of 10 chickpea lines, Turretfield 2009

*Percentage Yield Loss*

Yield loss, comparing ryegrass treatments to the nil treatments, was considered equally important to yield as an indicator of competitive ability with ryegrass. Across all varieties competition from ryegrass reduced grain yields by an average of 31% at Hart and 33% at Turretfield in the low ryegrass treatment, and 56% and 61%, respectively, in the high density treatment.

Breeder's line Chickpea 4 showed the lowest percentage yield loss at both ryegrass densities at Hart (9% and 38% loss at low and high densities respectively – Figure 2a). A similar result was found at Turretfield, with Chickpea 4 showing 8% and 51% yield losses at low and high ryegrass densities (Figure 2b). At both sites Sonali showed relatively low yield loss at the low ryegrass density only, while Chickpea 1 displayed relatively lower yield loss at the high density. All these varieties have good to very good levels of early vigour (Table 1).

Chickpea 2 suffered higher yield losses than most other varieties across both sites, supporting similar results in 2008. Other varieties showing high yield loss under ryegrass competition included PBA Slasher⊕, Genesis™079, Genesis™090, Almaz, CICA0512, and Chickpea 2. All these varieties have poor to moderate levels of early vigour, with the exception of Chickpea 2 which showed good early vigour.

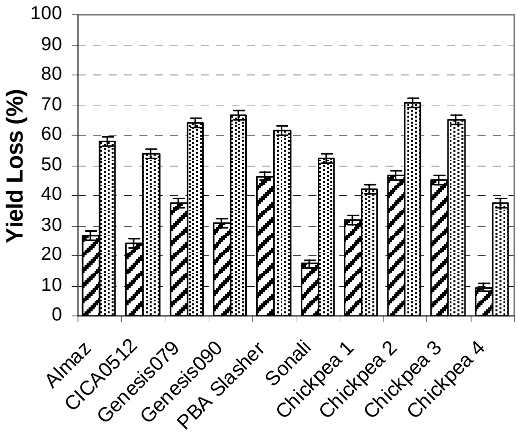


**Figure 2a:** Percentage yield loss of chickpeas under low and high ryegrass densities, Hart 2009

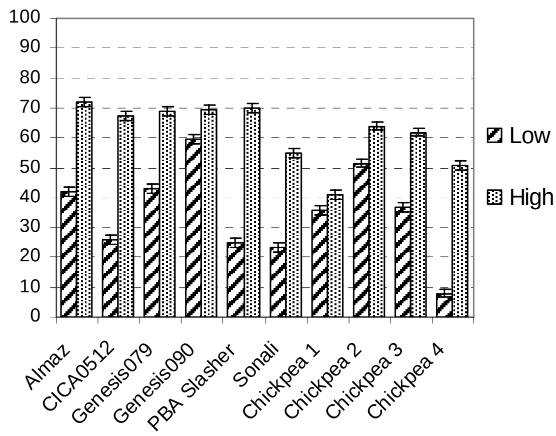


**Figure 2b:** Percentage yield loss of chickpeas under low and high ryegrass densities, Turretfield 2009

*Ryegrass plant and tiller counts*
The ability of chickpea lines to suppress tillering in ryegrass was deemed to be one of the most important measurements indicating competitiveness. Ryegrass tiller counts showed an almost four-fold increase in tillering in 2009 compared with that found in 2008.

Comparisons between low and high ryegrass treatments showed that ryegrass tillering was reduced by 39% at Hart and 25% at Turretfield as the sown ryegrass density was increased from 40 to 100 plants/m2. Ryegrass tillering, as for chickpea yield, was also higher at Hart than Turretfield (16 tillers/plant compared with 12 at the low density).

At Hart all varieties performed similarly in their abilities to reduce ryegrass tillering, regardless of ryegrass density. As with yield loss above, PBA Slasher and Chickpeas 2 and 3 were amongst the worst competitors at Hart (Figure 3a). Chickpea 4 was again found to be more competitive with ryegrass as it showed a 65% reduction in tillering compared to the crop-free treatment, and was more than 35% better than all other varieties (Figure 3a). In contrast, PBA Slasher featured as one of the best competitors based on ryegrass tiller suppression at Turretfield (Figure 3b), together with Chickpea 4. Although Genesis™079 and Sonali yielded well, Figure 3b shows relatively high ryegrass tillering in these varieties, once again suggesting that while they yield well they do not necessarily compete well with ryegrass. By contrast, Chickpea 4 consistently competed well with ryegrass, and yielded relatively well compared to other varieties.

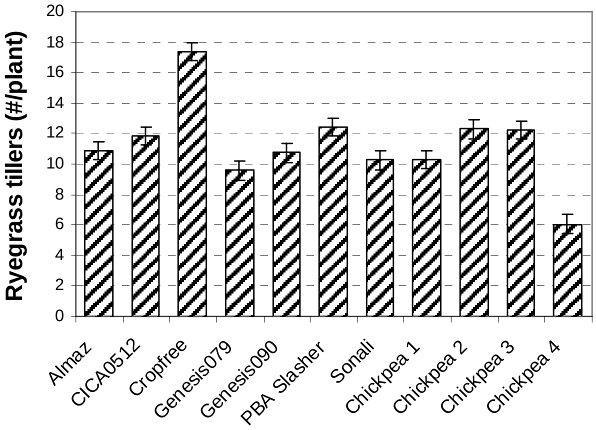


**Figure 3a:** Ryegrass tillering under competition with 10 chickpeas lines, Hart 2009.

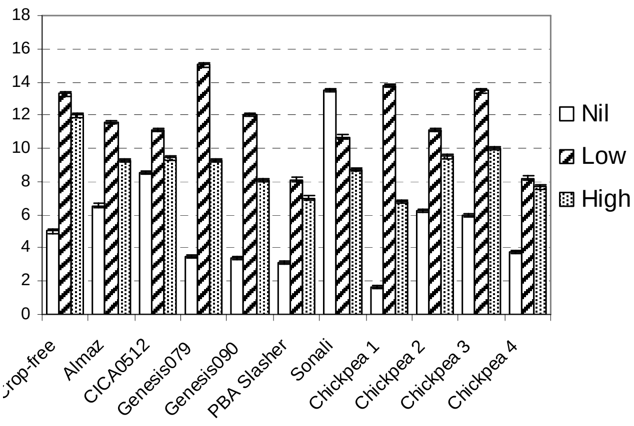


**Figure 3b:** Effect of ryegrass density on its tillering under competition with 10 chickpeas lines, Turretfield 2009.

**Key findings & comments**

- Although chickpea yields were higher than previous years, the rapid finish to the season favoured earlier flowering and maturing varieties such as Genesis™079 and Sonali.
- Ryegrass competition at 31 and 86 plants/$m^2$ reduced chickpea grain yield by 31% and 56%, respectively. Similarly, at Turretfield ryegrass at 41 plants/$m^2$ corresponded to 33% yield loss, and 62% at 123 plants/$m^2$.
- Similarities between moisture stresses caused by lack of finishing rainfall in 2009 and from competition with ryegrass meant that the same varieties yielded well with or without ryegrass competition eg Genesis™079.
- Breeder's line "Chickpea 4" recorded the lowest yield loss from ryegrass competition at both sites (9% at the low ryegrass density at Hart), and also displayed 35% better tiller suppression than other varieties at Hart.

- Early vigour appeared an important trait in chickpea for improved competivness with ryegrass, whilst short plant height was a disadvantage, but further work is required on a larger set of phenotypes and in a more favourable growing season.
- Some ambiguous results in 2009 (eg PBA Slasher and Chickpea 2) may be due to the unfavourable seasonal conditions for chickpea production which prevailed in SA last year. However they do indicate the need for more work in a more favourable growing season, and potentially on a larger set of phenotypes (particularly those similar to Chickpea 4).

**Acknowledgments**

The assistance of Mark Bennie, John Nairn, Peter Maynard and Rowan Steele, SARDI Clare, with trial management is gratefully acknowledged.

# Attachment 1

**G x M Experimental Protocols**
**2008**

1. Row Spacing (Jason Brand)
*Aim:* To investigate the adaptability of a range of lentil and chickpea varieties to inter-row sowing in wider row spacing's than conventional cropping systems.
Results from this trial will be used to provide advice to breeders on the characteristics required for modern inter-row and wider row cropping systems. These trials are comparisons of systems, not just row space.

*Treatments*
Crops: Lentils and Chickpeas
Sites: Wimmera (Horsham), southern Mallee (Curyo) and potentially southern NSW.
Varieties: To be determined. Will include varieties with a range of growth habits and maturities.
Row space treatments: Lentils: 20cm and 30cm; Chickpeas: 20cm, 30cm and 60cm(?? if possible??). 20cm treatment conventionally sown similar to current practise in breeding programs. 30cm sown inter-row into standing stubble
Measurements: Establishment, crop height, biomass, lodging, grain yield, quality and weight

2. Sowing time by Blackspot in Peas: (Larn McMurray)
*Aim:* To assess wether recent field pea breeding advancements in resistance to blackspot are significant enough to allow management changes to sowing time in this crop.
The ability to successfully sow field peas earlier in low and medium rainfall environments will maximise grain yield and crop reliability in these environments. Information will also be provided to PBA Field peas on the disease resistance level required to bring forward field pea sowing dates in low and medium rainfall environments. This experiment will occur for 1- 2 more years depending upon germplasm availability from PBA Field peas.

*Treatments*
Crops: Field Peas
Sites: Turretfield (lower Mid North, SA) & Hart (Mid North, SA)
Varieties: WA2211 (improved blackspot resistance), Alma (old conventional type standard), Kaspa (current semi-leafless standard), other improved breeding lines will be sought from PBA Field peas but likely to be limited by seed availability.
Fungicide treatments including: Nil, Fortnightly cholorothalonil, P-Pickel T & foliar mancozeb
Sowing times: 2-3 depending on season break; first at season break; second 2-3 weeks after first and a Third 2-3 weeks after second if still in a reasonable sowing window.
Measurements: Disease levels, grain yield and grain weight.

3. Crop-topping or desiccation effects on weed control and seed quality (Larn McMurray, Eric Armstrong and Jason Brand)
*Aim:* To determine the correct maturity timing required in field peas, chickpeas, lentils and faba beans for successful crop topping practice.
The ability to crop top pulses without incurring grain yield loss will improve management options for controlling resistant ryegrass in many cropping areas of southern Australian. Early harvest will also allow farmers to spread their harvest operation and allow more efficient use of machinery. Furthermore, harvesting at the optimum time improves seed quality and reduces weather damage

and soil contamination, thereby minimising or eliminating down grading of seed quality and maximising the marketability of the crop. Information will be provided to PBA on the maturity timing of genotypes to optimise control of ryegrass and maximise yield and seed quality.
SA trials to be based around ryegrass control (timing of sprays), NSW trials to based around seed quality and timing of harvest (not including lentils), Vic trials – only lentils and focussed on seed quality and harvestability, particularly of Boomer.

Varieties: Various in each crop representing the range of maturity timing available in each crop. Commercial standards will also be included.

Treatments (at least 3): 1. Nil
2.Early Gramoxone @ 1.0 L/ha at the rye grass milky dough stage to allow effective rye grass control.
3. On time Gramoxone @ 1.0 L/ha at the rye grass milky dough stage to allow effective rye grass control.
4. Late Gramoxone @ 1.0 L/ha two weeks after the early treatment

Measurements: Flowering dates, maturity dates, grain yield, seed moinsture, grain quality (where required) and grain weight.

<u>4. Weed Competition in chickpeas: (Larn McMurray)</u>

*Aim: To determine wether varietal differences in chickpea plant architecture effect their competitiveness with ryegrass.*

Preventing increases in resistant rye grass numbers during the chickpea phase of rotations is essential for maximum crop yield and sustainable cropping systems in southern Australia. Information will also be provided to PBA Chickpeas on the chickpea plant type required to maximise this crops competitiveness with rye grass.

Varieties: To be determined. Will include varieties with a range of growth habits and maturities. A number of advanced breeding lines suitable for evaluation were identified in PBA Chickpea breeding trials in 2007. Controls to include Almaz, CICA503, CICA512 Genesis 079, Genesis 090, Genesis 509 & Sonali

Treatments (3): 1. Nil ryegrass (no rye grass sown)
2. Low ryegrass density (sown with rye grass (SLR4 Biotype 4) at 40 plants/$m^2$)
3. High ryegrass density (sown with rye grass (SLR4 Biotype 4) at 100 plants/$m^2$)

Measurements: Grain yield, grain weight, rye grass numbers and importantly rye grass tiller numbers