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

2008 Results Summary

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Maturity differences in lentils at first desiccation timing in ryegrass management experiment, Kadina, SA

The trial site at Horsham, 2008

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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The authors wish to thank the contributions of the following people to this project:
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Jenny Davidson and Jim Egan, SARDI
Peter Matthews and Ian Menz, DPI NSW

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RESEARCH HIGHLIGHTS

In 2008, the pulse agronomic research project across south eastern Australia conducted several new trials to understand genotype by management interactions (Milestone 14). The Victorian component of the project has moved toward no-till cropping practices in line with the G x M research, with both site 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 a due for release from Pulse Breeding Australia. Many trials also provided opportunistic measurements (eg. desiccation response) which will provide valuable information to growers and advisors to maximise production in coming seasons.

Genotype x management (GxM)

- ROW SPACE/INTER-ROW SOWING, LENTILS AND CHICKPEAS: In lentils crop and pod height was increased by approximately 10% -30% in the 30cm row spacing. The grain yield in wider rows (30cm) with standing stubble was generally greater than in the narrow rows (19cm) and of wide rows with slashed stubble treatments. In Chickpeas, early sowing and wider row spacing's in standing stubble (60 and 30 cm c.f. 19cm) generally produced highest pod heights and grain yields.
- CROPTOPPING/DESICCATION: Some lines in all crops were found to incur yield loss and grain weight reductions at the appropriate timing for crop topping indicating poor suitability to this agronomic practice. In lentils, in one trial, it was noted that an early maturing line, CIPAL610, was significantly better adapted to croptopping than other lines, such as Boomer and Nugget.
- WEED COMPETITION BY PLANT ARCHITECTURE, CHICKPEAS: Trials confirmed chickpeas as a poor competitor, and the unsuitability of control measures such as weed-wiping and crop-topping due to yield losses from weed competition prior to application. Further work in more favourable seasons is required to compare genotypic differences of chickpeas to define a more competitive plant type.
- BLACK SPOT, FIELD PEAS: Kaspa & OZP0602 had lower disease severity and slower build up of blackspot than the old Alma cultivar and are therefore better suited to earlier sowing than this variety. OZP0602 shows high yields, wide adaptation and suitability to low and medium rainfall areas where it may not need to be sown as early as Kaspa to maximise yields, providing a safer option where sowing needs to be delayed due to disease, frost, weed or excessive growth issues

2009 DIRECTIONS: The number of crops, lines and treatments for all trials has been expanded and refined in 2008 based on 2007 findings. A copy of the original protocols is attached with this report.

Variety Specific Management

- LENTILS: CIPAL411 appears suited to earlier sowing and due to its early maturity may be suited to crop topping. CIPAL610 was the best adapted line to crop topping. Similar to previous seasons Nipper shows its highest yields sown at earliest dates and is well suited to early sowing due to its improved resistance to ascochyta blight and botrytis grey mould. Boomer is not as well suited to early sowing, as it tends to flower to early, increase frost risks. It is essential avoid delaying harvest of Boomer as it tends to shatter and drop pods.
- CHICKPEAS: Early or mid sowing dates generally produced the highest yield for chickpeas in 2008. Genesis 079 and CICA0503 performed particularly well in agronomy trials in Victoria and South Australia.

Trials conducted in 2008 on new pulse varieties across south-eastern.

	Chickpeas									Faba beans			
Experiment	**Genesis 090**	**Genesis 509**	*Almaz*	*Nafice*	**CICA 503**	**CICA 505**	**CICA0512**	**Genesis 114**	*Genesis 079*	**Farah**	**Nura**	**974*(611*974)/15-1**	**1269*483/6-1**
Sowing date	W, sM, NSW, YP	W, sM, NSW YP	W, sM		W, sM, NSW YP	W, sM, NSW YP	NSW	W, sM	W, sM, NSW YP	NSW mN	NSW mN	NSW	NSW mN
Plant density	W, NSW,YP	W, NSW,YP	W, NSW		W, NSW, YP	W, NSW,YP	NSW	W	W, NSW,YP				
Row spacing	W, sM, NSW?	W, sM	W, sM		W, sM	W, sM	NSW?	W, sM	W,sM				
Herbicide tolerance	W	W	W		W	W		W	W				
Fungicide management	W, sM	W, sM						W, sM	W, sM	mN	mN		mN
Wide scale release[2]	2005	2008	2008	2008	2009	2009	??	2009	2009	2005	2006	??	??

	Lentils						Field peas				
Experiment	**Nipper**	**Boomer**	**CIPAL 411**	**CIPAL 415**	**CIPAL501**	**CIPAL610**	**OZP0602**	**OZP0601**	*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					
Plant density							NSW	NSW	NSW	NSW	
Row spacing	W, sM	W, sM	W, sM	W, sM	W, sM	W, sM	NSW	NSW	NSW	NSW	
Herbicide tolerance											
Fungicide management	W, sM cYP,nYP	W, sM cYP,nYP	W, sM cYP,nYP	W, sM	cYP,nYP	cYP,nYP					
Harvest timing		W,c									
Wide scale release[2]	2007	2007	2009	2009	2010	2010	2009	2009	??	??	2007

[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 Genesis 090 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, 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 - Genesis 079, Genesis 090, Genesis 114
	Desi – Genesis 509, CICA0503
Sowing dates:	6 May (Early), 27 May (Mid), 17 June (Late)
Plant densities:	20, 35, 50 and 70 plants/m^2
Fertiliser:	MAP + Zn @ 90kg/ha at sowing

Results and Interpretation

Grain yield

Across all varieties a 21% yield penalty occurred from sowing chickpeas at the early sowing time compared with the mid sowing time (Figure 1a). The major reason for this is likely to be ‘haying off’ caused by high biomass levels combined with the very dry seasonal finish leaving insufficient moisture for grain fill. This is evident when comparing plant biomass (Figure 4), which was 23% greater for early-sown than mid-sown chickpeas, and grain weights (Figure 3), which were generally much smaller when sown at the early date. Chickpeas are more sensitive to low temperatures during flowering and pod fill than other pulses. Therefore another reason for the lower yields in the early sowing time could the more common occurrence of low temperatures during flowering in this treatment.

Varieties performed differently to changes in sowing time in 2008 (Figure 1a). CICA0503, Genesis 509 and Genesis 079 were the highest yielding lines at the early sowing time, CICA0503 at the mid timing, and Genesis079 and CICA0503 at the late. Genesis 509 generally showed a flatter response to sowing date changes than all other varieties and was the only variety not to incur a yield penalty from early sowing. CICA0503 was the most sensitive variety to sowing date changes and along with Genesis 509 incurred a yield loss when sown late compared with the mid sowing date.

Changes in plant density had a relatively small effect on grain yield (Figure 1b). Across all varieties at the early sowing time the 20, 35 and 50 plants/m^2 treatments had the same yields and a 15% yield loss occurred at 70 plants/m^2 compared with the 20 plants/m^2 rate. At the mid and late sowing times 35, 50 and 70 plants/m^2 had the same yields however 10 and 20% yield losses, respectively, occurred at the 20 plants/m^2 treatment.

There was no significant difference in yield within each variety, but between varieties yield differences became more apparent as plant density was increased (Figure 2). The smaller seeded varieties (CICA0503, Genesis 509 and Genesis 079) out-yielded the larger seeded varieties (Genesis 090 and Genesis 114) at the higher plant densities.

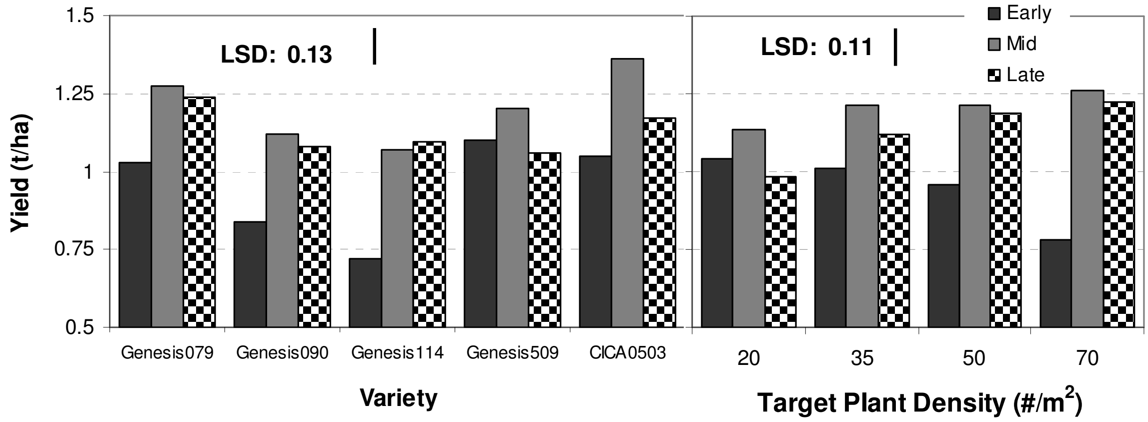


Figure 1a: Effect of sowing time on grain yield of five chickpea varieties, Paskeville, 2008.

Figure 1b: Effect of sowing time on grain yield of chickpeas sown at varying plant densities, Paskeville 2008.

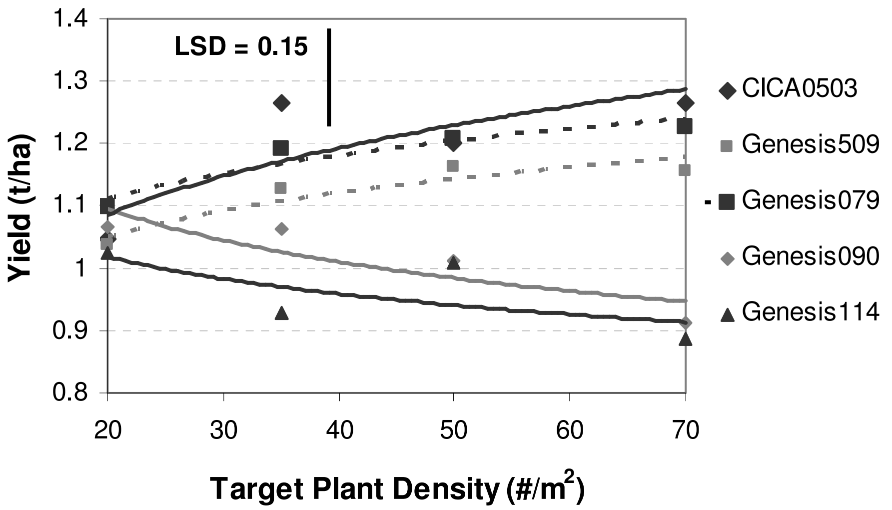


Figure 2: Effect of plant density on yield of five chickpea varieties, Paskeville 2008

Grain weight

Grain weights of all chickpea varieties increased as sowing time was delayed (Figure 3a), which is likely due to both fewer pods set (therefore a lower sink:source ratio) and conservation of moisture due to less biomass production (Figure 4a).

Genesis 114 showed an increase in grain weight at the late sowing time which was not seen in other varieties. Increasing plant densities generally decreased grain weights for each sowing time (Figure 3b), however the slope of this decrease reduced as sowing date was delayed. Grain weights of the earlier sown chickpeas were likely to be more sensitive to changes in plant density because of their higher biomass production making them more prone to “haying off” during the dry spring.

Genesis 090 had higher grain weights than Genesis 079, the new small seeded kabuli variety, while the new desi CICA0503 showed considerable grain size improvement over Genesis 509 (Figure 3a).

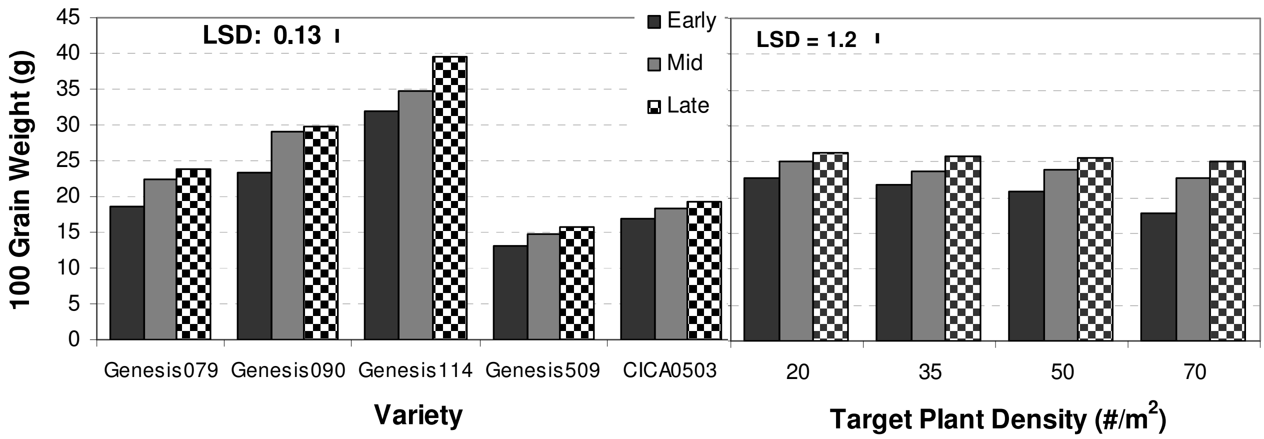


Figure 3a: Effect of sowing time on grain weight of five chickpea varieties, Paskeville, 2008.

Figure 3b: Effect of sowing time on grain weight of chickpeas sown at four different plant densities, Paskeville, 2008.

Biomass

Biomass was shown to decrease considerably as sowing was delayed (Figure 4a). Increasing plant density from 20 to 35 plants/m^2 increased biomass, but not thereafter (Figure 4b). There were no varietal differences to changes in plant biomass across sowing times.

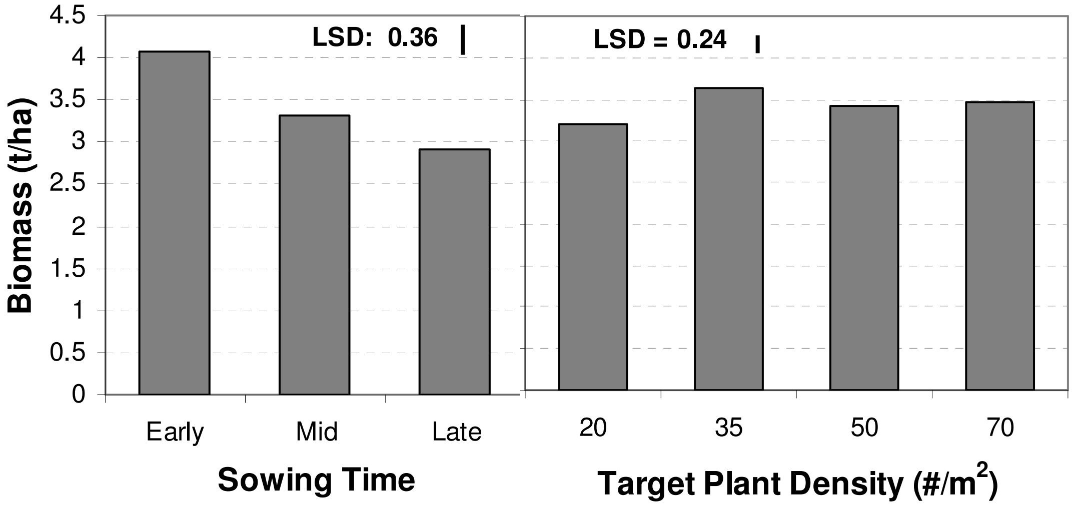


Figure 4a(L): Effect of sowing time on biomass of chickpeas at Paskeville, 2008

Figure 4b(R): Effect of plant density on biomass of chickpeas at Paskeville, 2008

Key Findings and Comments

- Dry spring conditions suppressed grain yields and grain weights, and led to "haying off" in early sown (May 6) chickpeas compared to those sown at mid and late dates.
- All chickpea varieties incurred a yield penalty from early sowing in 2008 unlike in lentils and peas where select varieties were favoured or not penalised from this practice. All current chickpea varieties are more sensitive than other pulses to cold temperatures at flowering and pod fill which could explain the poor yields at the early sowing time. Severe 'haying off' was observed in the high seeding rate treatments of the early sowing time due to the dry spring conditions further penalising the early sown treatments.
- The dry season generally favoured the early maturing and short plant type of Genesis 079, especially when sown late, and the mid flowering, ascochyta blight resistant desi CICA0503 when sown mid. These lines performed 8 and 9% better than the site mean yield.
- Chickpea yields were generally better at lower plant densities when sown early, and higher densities when sown later although yield differences were relatively small (less than 0.2t/ha). However, past research has shown that this is often likely to reduce grain size which could be an issue if large seed size is required for attracting price premiums paid on grain size (particularly in large kabuli types). Furthermore the small yield gains from higher rates seen in 2008 are unlikely to be economic and lower plant densities (20 plants/m^2) are not recommended due to issues associated with weed competition. Hence, current chickpea densities of 35 plants/m^2 for kabuli (small and large) and 50 plants/m^2 for desi remain best-practice for varieties evaluated.
- Grain weights, as seen in previous years, were generally lower when sown early, most likely due to the larger numbers of pods set at these sowing times increasing competition for resources at the end of the season. However, apart from in Genesis114, these differences were relatively small.

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

TRIAL 4: Chickpea Plant Density, Yenda, New South Wales

Key Findings

- Low plant populations significantly reduced grain yields in the 2008 season.
- Plant densities above the currently recommended target range for southern NSW of 35 - 45 pl/m^2 were significantly higher yielding under the dry conditions of 2008.

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

Trial Details
Location: "Hillview" Yenda, NSW
Soil type: Red Sandy Loam.
Previous crop: Barley, continuously cropped for 9 years.

Treatments:

	Varieties	
Desi chickpeas	CICA 0503 Flipper	CICA 0512 Genesis 509
Kabuli chickpeas	Genesis 090 Genesis 114	Genesis 079
Target Plant Populations/m^2	12, 24, 36, 48 & 60	

Trial management:

Sowing rate	various
Row Spacing	30 cm
Sowing date	18th June
Fertiliser	115kg/ha Grain Legume
Herbicide	Metribuzin 750g/kg PSPE 180g/ha on 25th June Select 300ml/ha 28th August
Insecticide	Fastac 200ml/ha 3rd October
Harvest date	1st December

Method

Eight varieties and five targeted plant populations listed above were used. Plots were sown into moisture in a zero-tillage system using a cone-seeder on 30cm row spacing with Janke knife tynes. Press wheels directly followed the tynes to maximise seed-soil contact at the rear of the machine.

Trial Results

Yield

The variety of chickpea had no significant effect on grain yields at this site. The interaction of variety by plant population was also found to be not significant. There was however a significant response ($P<0.001$) to increasing plant population in chickpeas at this site.

Discussion

Under dry spring conditions, the overall yields were reduced to what would be expected in an average year.

Statistical analysis showed whilst there was no significant difference between varieties, plant population had a major effect on grain yields. Across the range of varieties, grain yield showed a linear response to increasing plot densities, see Figure 1. For every additional chickpea plant above 10 plants/m^2, 7.5 kg/ha of extra grain yield was produced.

Given the dry hot conditions late in spring, the lower plant densities were unable to compensate for yield, by the growth of additional branches or increasing flowering nodes on the main branches.

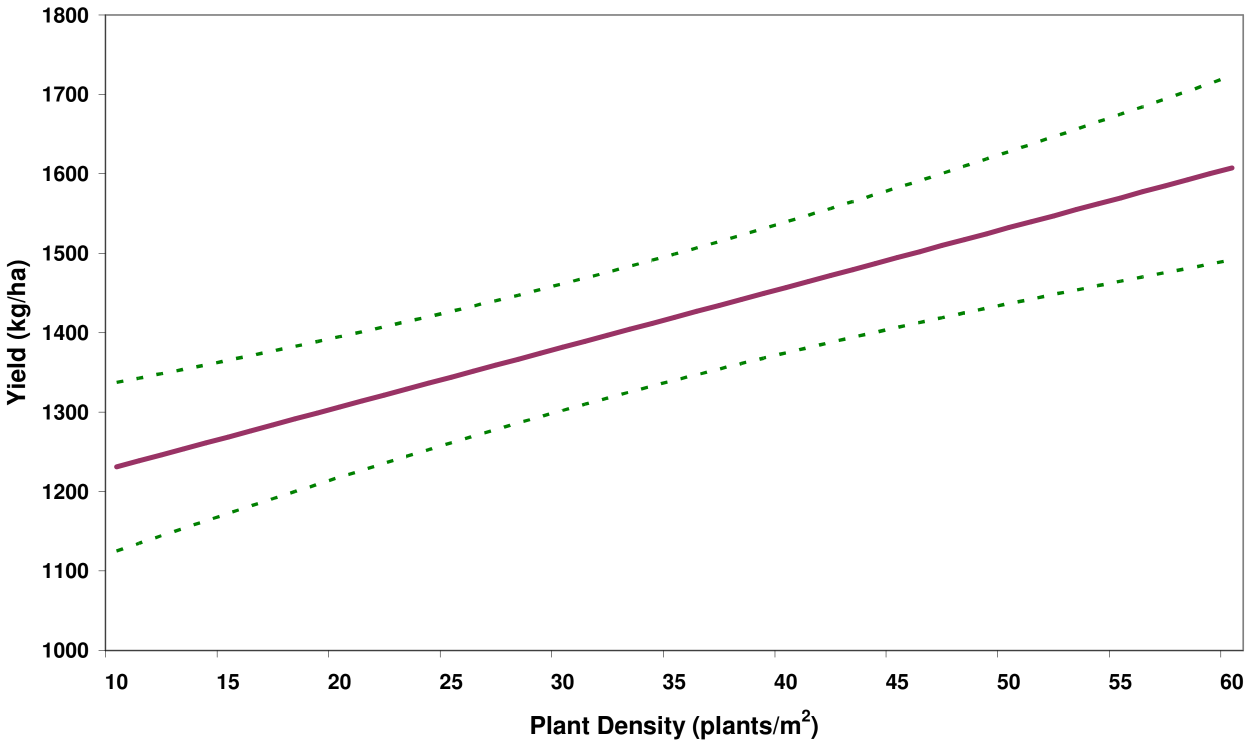


Figure CP1: Chickpea yield response curve (solid line) to increasing plant population (95% confidence intervals broken lines) at Yenda in 2008.

Under these drought conditions it is difficult to recommend plant populations from this trial, for seasons with rainfall closer to average.

This is still valuable data for understanding plant densities responses under drought conditions as experienced in 2008, showing that having low plant populations was detrimental to potential crop yields.

TRIAL 5: Chickpea Plant Density, Temora, New South Wales

Key Findings

- Low plant populations significantly reduced grain yields in the 2008 season.
- All varieties responded in a similar manner to increasing plant densities under the 2008 seasonal conditions

Trial Aim

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

Trial Details

Location: Temora, NSW
Soil type: Red Brown Earth.

Previous crop: Fallow.

Treatments:

	Varieties	
Desi chickpeas	Flipper	Genesis 509
Kabuli chickpeas	Genesis 090 Genesis 079	Genesis 425
Target Plant Populations/m^2	10, 20, 30, 40 & 50	

Trial management:

Sowing rate	various
Row Spacing	18 cm
Sowing date	5th June
Fertiliser	110 kg/ha Granulock 15
Herbicide	1.2 l/ha Stomp pre sowing Metribuzin 480g/l PSPE 400ml/ha 1.5 l/ha Simazine 625 70 ml/ha Verdict
Insecticide	-
Harvest date	December

Method

Five varieties and five targeted plant populations listed above were used. Plots were sown into moisture into a pre pared seed bed using a cone-seeder on 18cm row spacing. A rubber tyred roller was used to firm the seed bed and to maximise seed-soil contact.

Trial Results

Yield

There was a significant linear response (P<0.001) to increasing plant population in chickpeas at this site and a significant response to variety (P<0.001). There was no significant interaction of variety by plant density.

Discussion
Under dry spring conditions, the overall yields were severely reduced to what would be expected in an average year.

Yield increased as plant density increased for all varieties. Given the dry hot conditions late in spring, the lower plant densities were unable to compensate for yield, by the growth of additional branches or increasing flowering nodes on the main branches.

Under these drought conditions it is difficult to recommend plant populations from this trial, for seasons with rainfall closer to average. This is still valuable data for understanding plant densities responses under drought conditions as experienced in 2008, showing that having low plant populations were detrimental to potential crop yields

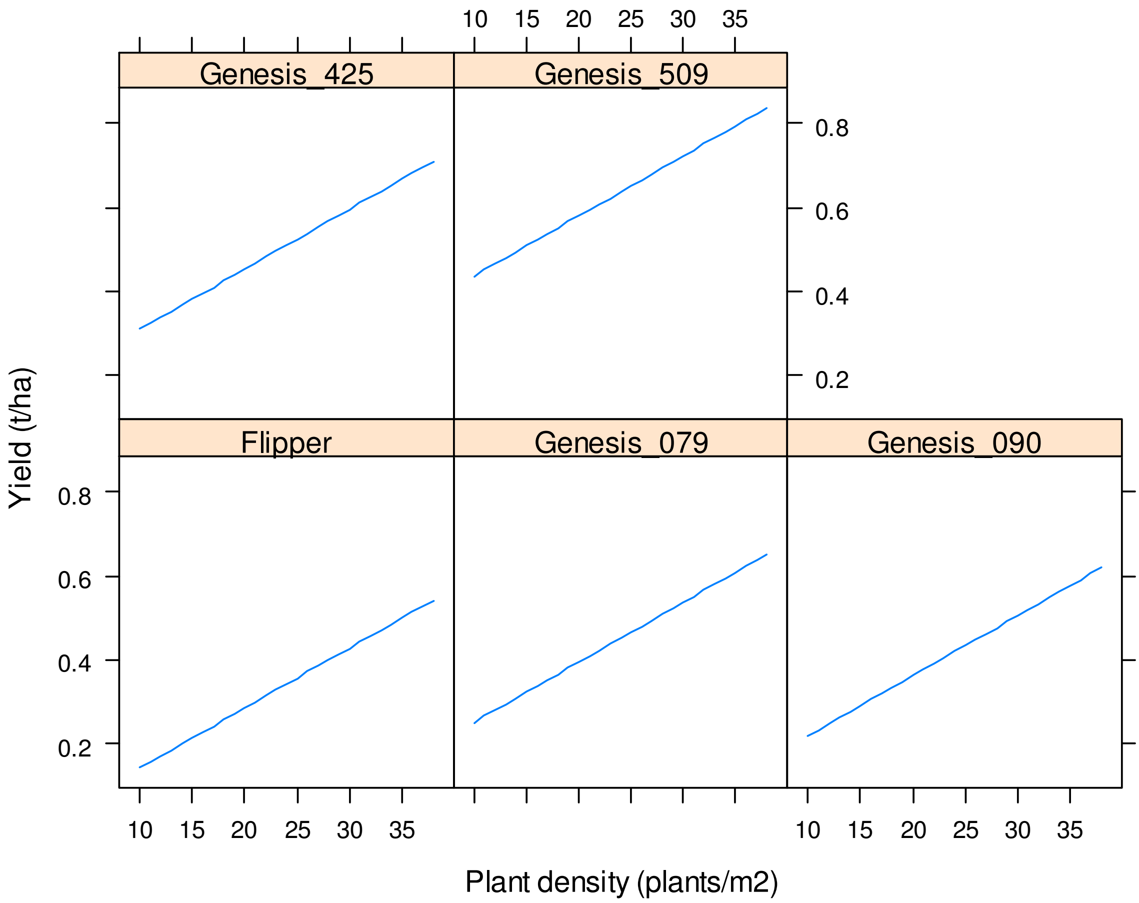


Figure CP2: Chickpea varietal yield response curves to increasing plant population at Temora in 2008.

TRIAL 6: Chickpea Plant Density, Galong-Harden, New South Wales

Key Findings

- Low plant populations significantly reduced grain yield.
- Grain yield increased with increasing plant population, peaking at around 40 plants/m^2 for all varieties.
- A dryer then average season prevented all treatments from reaching their yield potentials.
- This is our highest average rainfall site and further testing is required to determine optimum plant population ranges for this region under more normal conditions.

Trial Aim

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

Trial Details

Location: Galong, NSW
Soil type: Red Sandy Loam.

Previous crop: Barley.
Treatments:

	Varieties
Desi chickpeas	CICA 0503 CICA 0505 CICA 0512 Flipper Genesis 509
Kabuli chickpeas	Genesis 090 Genesis 079 Genesis 114
Target Plant Populations	24, 36 & 48

Trial management:

Sowing rate	various
Sowing date	24th June
Fertiliser	115kg/ha Grain Legume
Herbicide	Glyphosate pre-sowing
Harvest date	23rd December

Method

Eight varieties and three targeted plant populations listed above were used. Plots were sown into moisture in a zero-tillage system using a cone-seeder on 30cm row spacing with Janke knife tynes. Press wheels directly followed the tynes to maximise seed-soil contact.

Trial Results
Yield
Chickpea grain yield responded significantly to increasing plant population at this site, with all varieties responding similarly (ie no significant interaction of variety by plant population). Varieties yielded significantly different from each other.

Discussion
Varieties differed significantly in grain yield at this site but all responded similarly to increasing plant density, peaking at around 39 plants/m^2 before declining.

Genesis 509 (the quickest maturing chickpea varieties) was one of the highest yielding, suggesting the season did finish prematurely at this site. Further work is required to look at plant density effects under more average conditions for this higher rainfall environment.

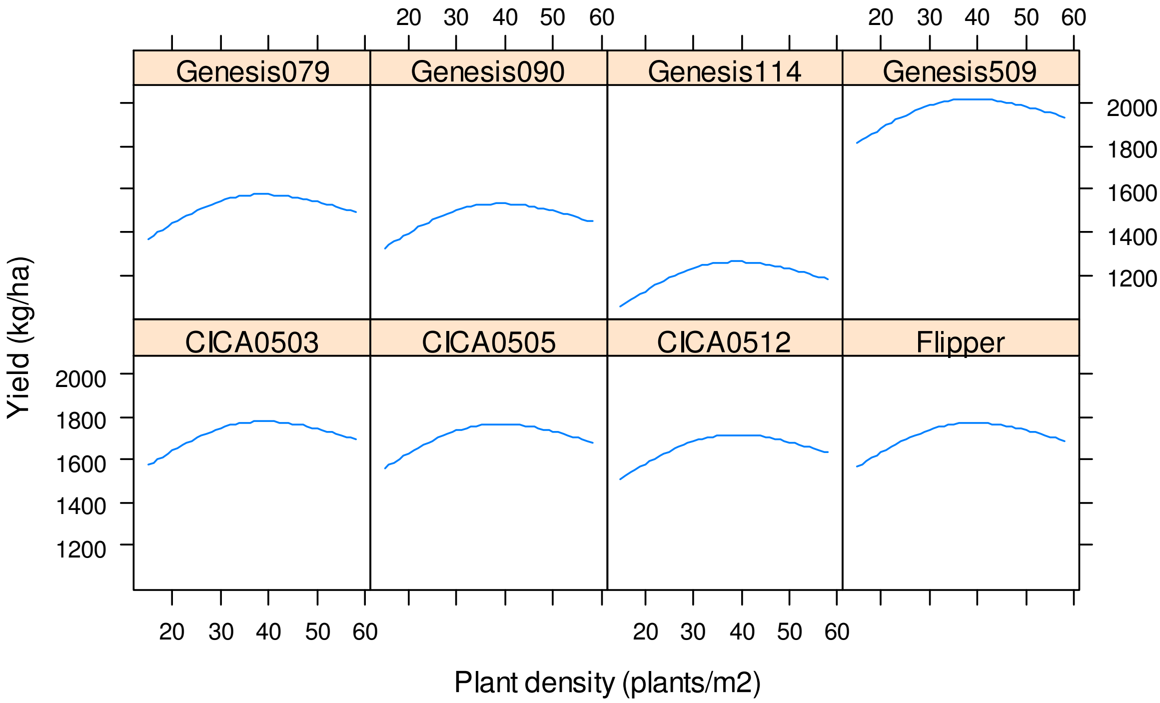


Figure CP3: Chickpea varietal yield response curves to increasing plant population at Galong-Harden in 2008.

TRIAL 7: Chickpea Row Spacing, Yenda, New South Wales

Key Findings

- Row spacing of 20 & 30 cm was significantly higher yielding then 40 & 50 cm treatments.
- All varieties behaved similarly under different row spacing treatments with no significant variety by row spacing interactions.

Trial Aim

To investigate and model the effects of changing row spacing on chickpea yield in southern NSW. The information from this trial plus others is used to validate and improve grower recommendations.

Trial Details

Location: "Hillview" Yenda, NSW
Soil type: Red Sandy Loam.

Previous crop: Barley, continuously cropped for 9 years.

Treatments:

	Varieties	
Desi chickpeas	CICA 0503 Flipper	CICA 0512 Genesis 509
Kabuli chickpeas	Genesis 090	
Row Spacing	20, 30,40 & 50 cm	

Method

Plots were sown into moisture in a zero-tillage system using a cone-seeder with adjustable tool bar with Janke knife tynes. Press wheels directly followed the tynes to maximise seed-soil contact at the rear of the machine. Plots consisted of two adjacent runs of the cone-seeder to provide enough rows for the wider row spacing and to minimise edge effects.

Trial management:

Sowing rate	35 plants/m^2
Sowing date	19th June
Fertiliser	115kg/ha Grain Legume
Herbicide	Metribuzin 750g/kg PSPE 180g/ha on 25th June Select 300ml/ha 28th August
Insecticide	Fastac 200ml/ha 3rd October
Harvest date	28th November

Trial Results

Yield

The interaction of variety by row spacing was found to be not significant. However both the main effects of variety ($P < 0.001$) and row spacing ($P<0.05$) were significant.

Discussion

Under the dry spring conditions of 2008, the overall yield potential of all varieties was reduced, compared to what would be expected in an average year.

Whilst the statistical analysis showed there was a significant difference between row spacings, there was no variety effect with all the varieties responding similarly to increasing row spacing. As shown in Figure 1 there was no significant difference between row spacings of 20cm and 30cm.

However the wider rowspacing of 40cm and 50cm showed a significant yield reduction compared the 20cm and 30cm spacings as well as to each other.

From this data, we can suggest that a row spacing of 30cm incurs no yield decline when compared to the traditional 20cm row spacing. These results are similar to those reported for the 2007 season where 19cm and 30 cm row spacing showed no significant differences in grain yield.

Variety choice was also important at this site with the each varieties overall yield potential being different, with the earlier maturing line Genesis 0509 the best performing variety under the conditions in 2008 (Figure 2).

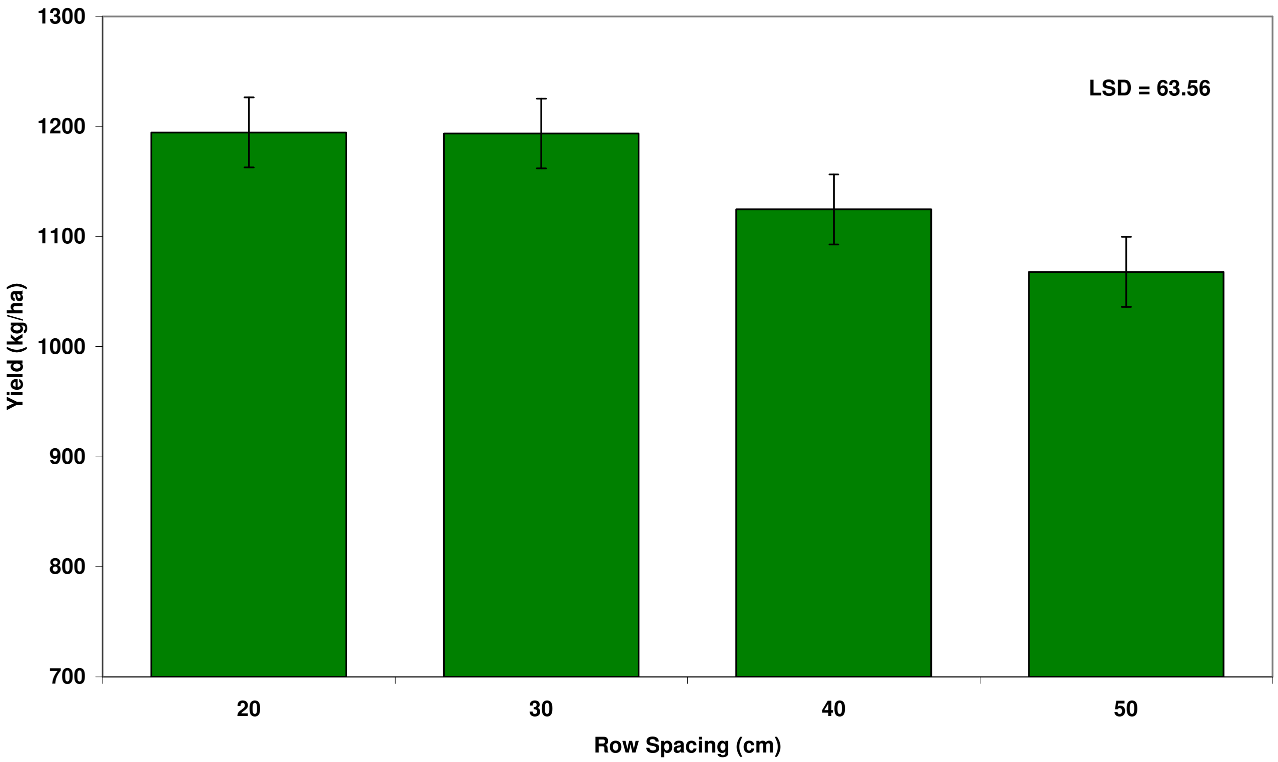


Figure CP5: Yield responses of chickpea to different plant row spacing at Yenda in 2008.

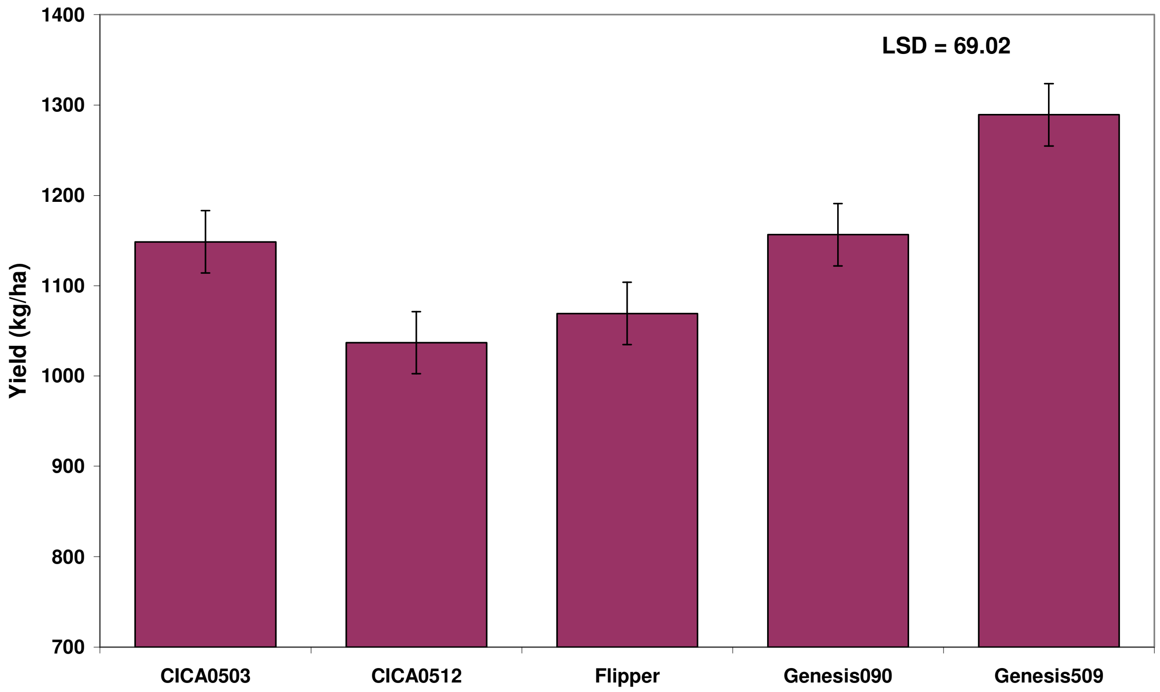


Figure CP6: Chickpea yield response to variety at Yenda in the row spacing trial in 2008.

TRIAL 8: Chickpea Time of Sowing, Wagga, New South Wales (also includes Faba Beans)

Key Findings

- In dry years, sow faba bean and chickpea as early as possible in the recommended sowing window
- Grain yield declined significantly as sowings were delayed from 30th April through to 7th July
- Faba bean was far more sensitive to delays than chickpea –they lost on average 21 kgs seed/ha/day over this period compared to only 7 kgs seed/ha/day for chickpea.

Trial Aim

To investigate and model the effect of time of sowing on grain yields of chickpea and faba bean in southern NSW. The range of sowing dates include very early to very late from within the recommended sowing window. The information from this trial plus others is used to validate and improve grower recommendations.

Trial Details

Location: Wagga Wagga, NSW
Soil type: Red brown earth.

Trial management:

Sowing rate	Chickpeas - 35 plants/m^2 Faba beans - 25 plants/m^2
Fertiliser	115kg/ha Grain Legume
Herbicide	21st May - 2 l/ha Stomp + 1.6 l/ha Avadex xtra 500 ml/ha Sencor 480 PSPE
Insecticide	26th May - 100 ml/ha
Harvest date	14th Nov & 9th Dec

Treatments:

	Varieties	
Desi chickpeas	CICA 0503 CICA 0505 Genesis 509	CICA 0512 Flipper
Kabuli chickpeas	Genesis 079 Genesis 114	Genesis 090
Faba bean	Farah	Nura
Sowing date	TOS 1 30th April	
	TOS 2 21st May	
	TOS 3 11th June	
	TOS 4 7th July	

Method:
Eight chickpea varieties and 2 faba bean varieties were sown over 4 sowing dates. Plots were sown into varying moisture conditions due to seasonal variations. However, there was adequate moisture to ensure germination and emergence in each sowing date.

All plots were sown in a zero-tillage system using a cone-seeder with Janke knife tynes. Press wheels directly followed the tynes to maximise seed-soil contact.

Trial Results and discussion

Grain yield

The interaction of variety by sowing time was found to be highly significant. Sowing time and variety were also found to be both highly significant.

Grain yields declined in a near linear relation with the delay in sowing time for both chickpea and faba bean. (R^2 = 0.95 and 0.99 for chickpea and faba bean respectively - see Figure TOS1). Yield decline was far more severe in faba bean therefore proving to be more sensitive to delays in sowing time.

At an individual variety level, all varieties in TOS 1 were significantly higher yielding than the rest of the treatments. There were some variety differences at each TOS but the magnitude far less than sowing time (see Figure TOS 2).

Seed size

For a given variety, chickpea seed size increased significantly as sowing was delayed but decreased significantly in faba bean (see Figure TOS 3). There were large variations in seed size across the different varieties of chickpea and faba bean.

Seed size was highly significantly different across the range of sowing times and varieties used in this experiment, as was the interaction of variety by sowing time.

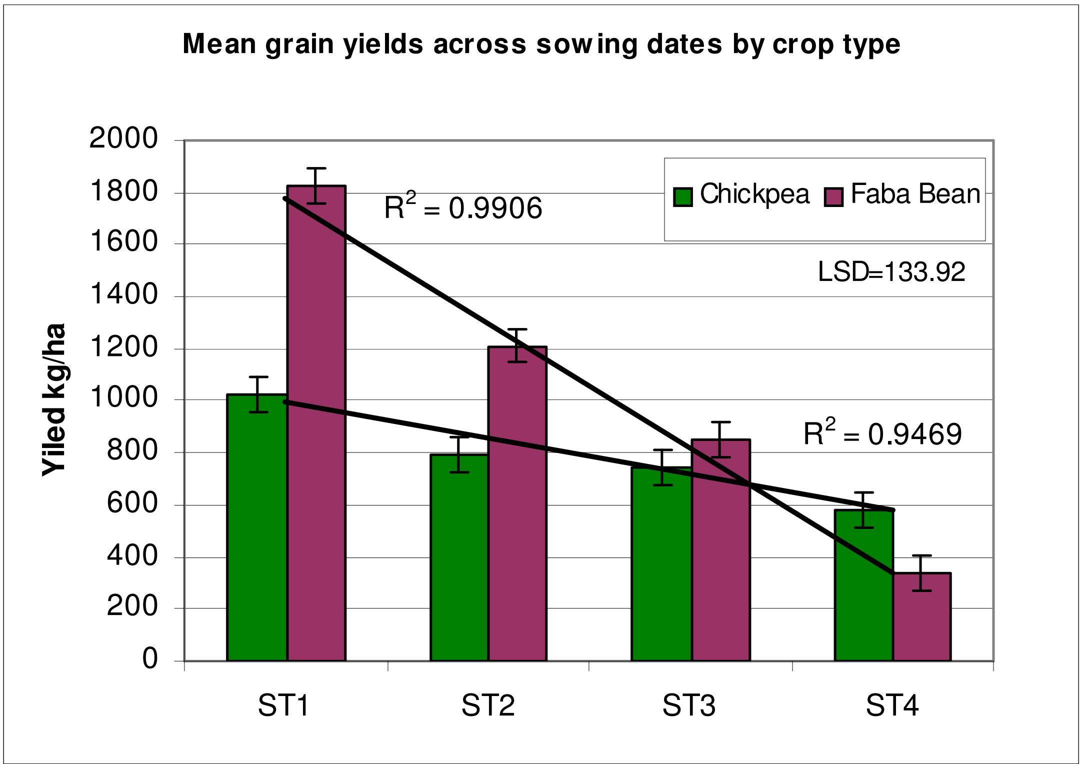


Figure TOS1: Mean grain yields of Chickpeas and Faba beans across sowing dates.

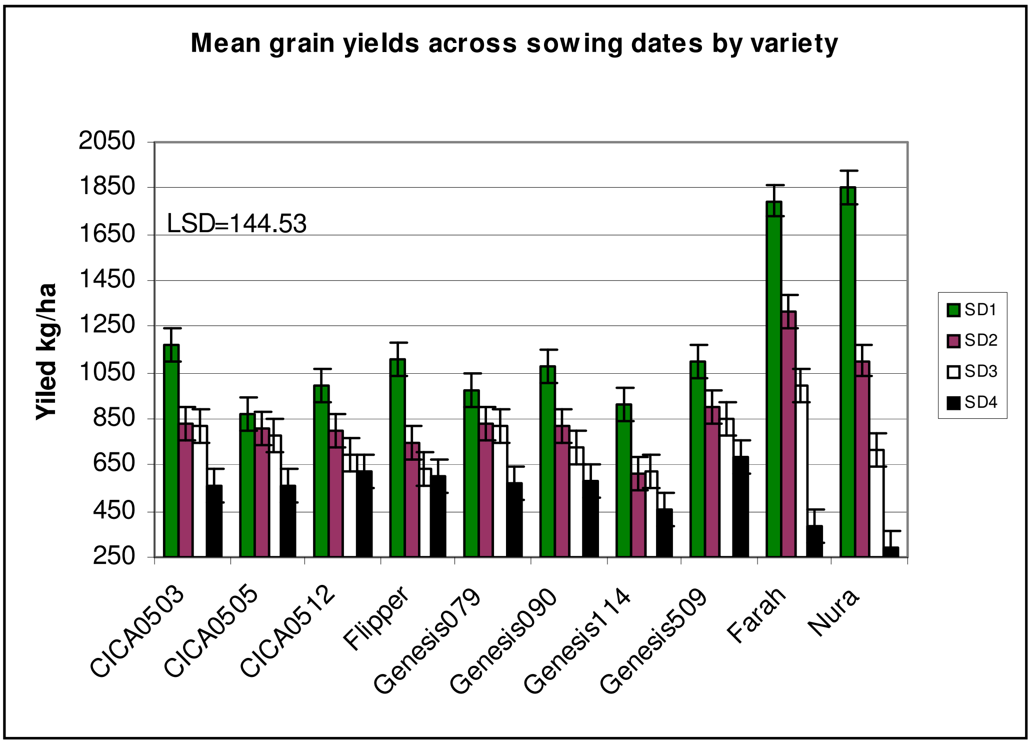


Figure TOS2: Mean yield responses for all chickpea and faba bean varieties.

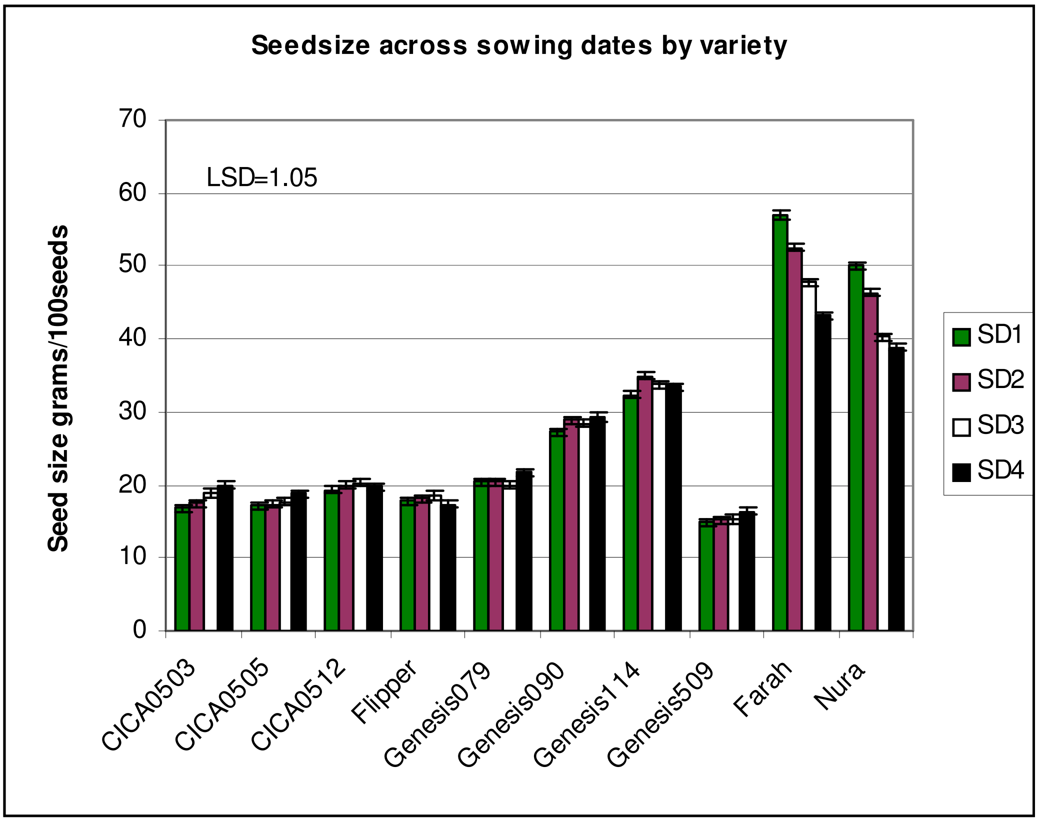


Figure TOS3: Chickpeas and Faba beans seed size across sowing dates.

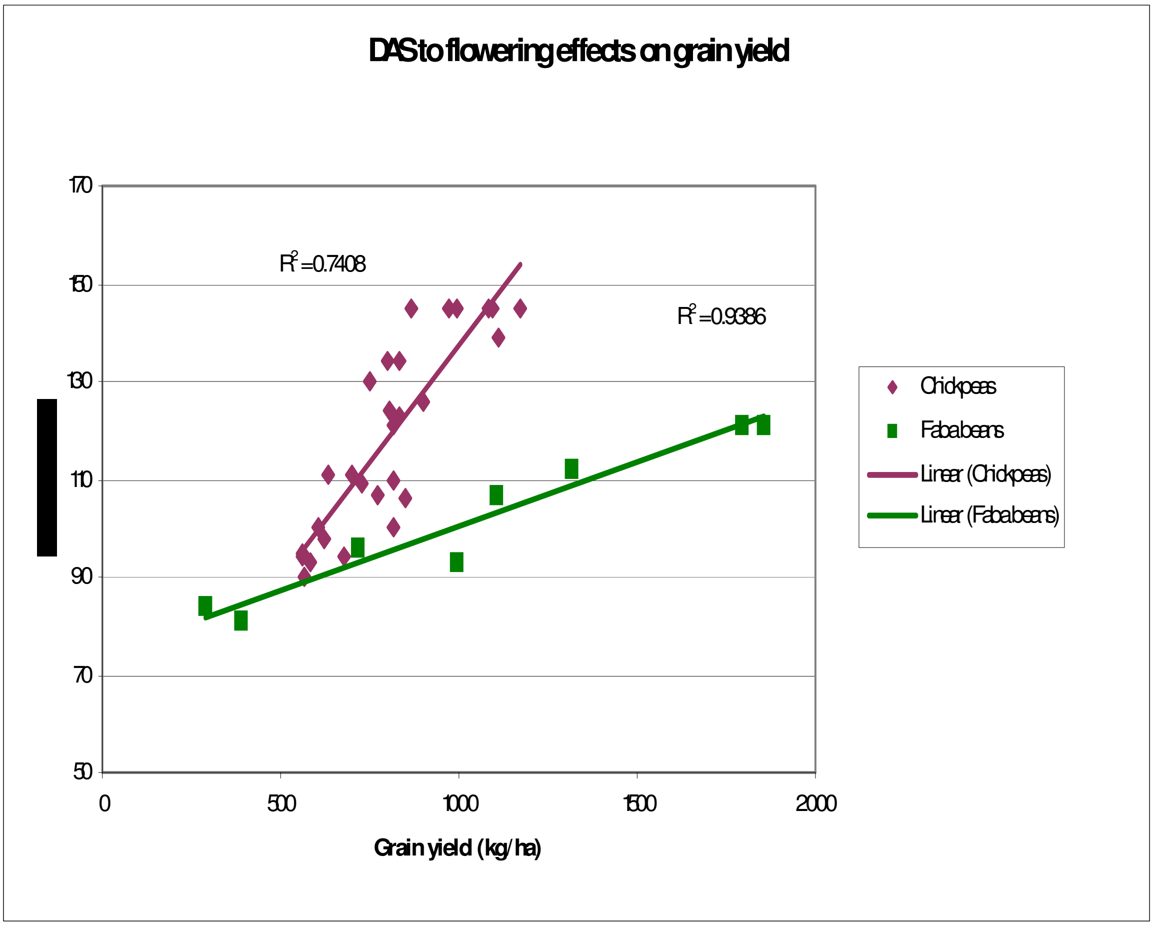


Figure TOS4: Correlation between days from sowing to flowering and total grain yield for chickpeas and faba beans.

Flowering time

There was a strong correlation between days to flowering and grain yield for both chickpea (R2=0.74) and faba beans (R2=0.94) - the longer the vegetative period (prior to flowering) the greater the grain yield (figure TOS4).

TRIAL 9: Chickpea Time of Sowing, Cowra, New South Wales

Key Findings

- All varieties had the same yield response to delayed sowing in the 2008 season.
- Yield significantly declined as sowing was delayed from 6th May through to the 13th June.
- Length of flowering time was a major factor in chickpea yield response to the season.

Trial Aim

To determine the yield, grain quality and flowering day response of chickpea varieties to time of sowing (TOS).

Trial Details

Location: *Cowra, NSW.*

Soil type: Red Chromosol

Soil test values:

Depth	0-10 cm
pH	5.2, Al% = 1.5
Colwell P	30
Organic C (%)	0.89
CEC	4.9

Previous crop: Triticale.

Treatments:

	Varieties	
Desi chickpeas	CICA 0503 Flipper	CICA 0512 Genesis 509
Kabuli chickpeas	Genesis 079 Genesis 114	Genesis 090
Sowing date	TOS 1 6th May	
	TOS 2 23rd May	
	TOS 3 13th June	

Trial management:

Sowing rate	Target plant population of 35 pl/m^2
Sowing date	-
Emergence date	TOS 1 22nd May (16 days) TOS 2 9th June (17 days) TOS 3 7th July (24 days)
Fertiliser	100 kg/ha Trifos
Herbicide	29th April - 1L PowerMax + 1L + 300ml Agri Buffer 6th May - TOS 1 - 830g Gesatop 900 250 ml Platimum + Uptake 26th May 800g Gesatop 900 28th May – TOS 2
Insecticide	300 ml Fastac 3rd November
Fungicide	-
Harvest date	3rd December

Trial Results

Plant establishment

Significant plant establishment effects were found between the chickpea varieties. Flipper had the highest population of 45 plants/m^2, while Genesis 114 the lowest with 24 plants/m^2. However, time of sowing was not significant (Table 2). There was however a variety by time of sowing interaction but only at the 5% level.

Flowering time

The start of flowering, end of flowering and flowering duration were significant for variety and the variety by sowing time interaction (Table 2). However, time of sowing was only significant for start of flowering and end of flowering.

On average, TOS 1 started flowering 7 days earlier than TOS 2 which was 9 days earlier than TOS 3. Genesis 079 was the earliest variety to flower for all sowing dates. Genesis 114 was the last to start flowering.

Yield

There were significant differences in yield response by varieties in this trial (Table 3). There were also significant time of sowing effects, with a decline in yield, as sowing was delayed (Figure 2). However there was no interaction with genotype and sowing time, with all varieties having the same yield response across sowing times in the trial.

Genesis 079 (small-seeded kabuli) was the highest yielding variety in all sowing times. Genesis 114 (large-seeded kabuli) was the lowest.

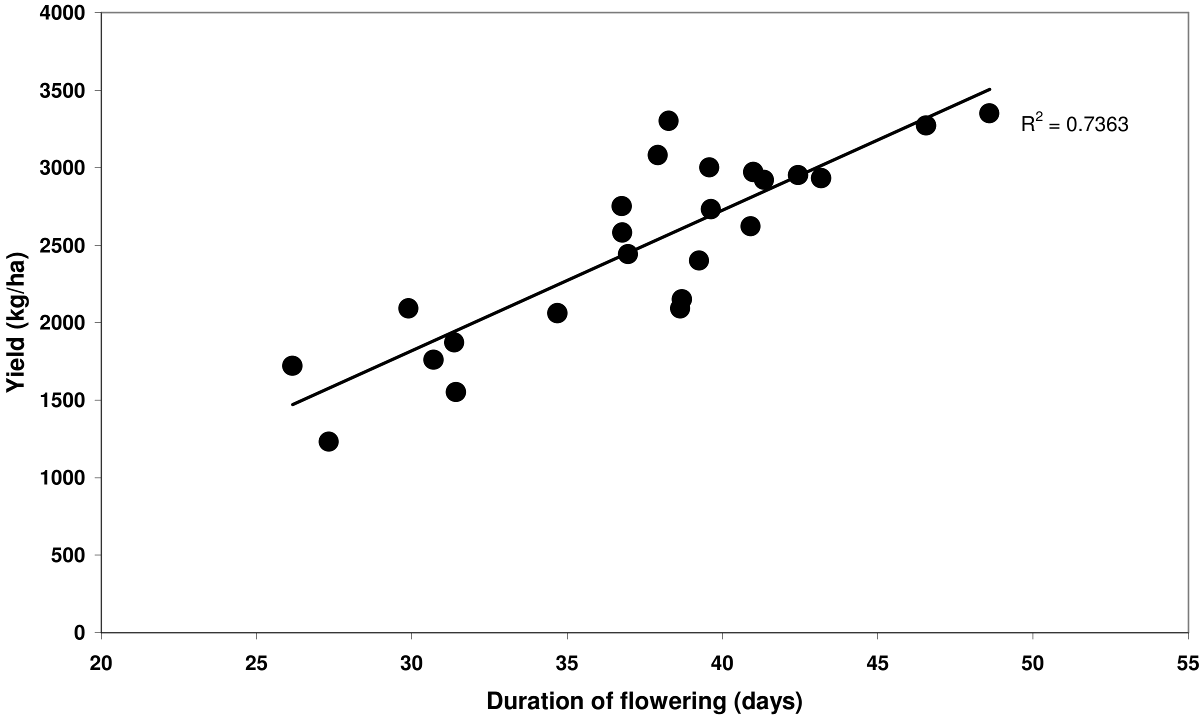


Figure TOS5: Effects of flowering time duration on the yield response of chickpeas at Cowra in 2008.

Seed size
Variety, time of sowing and the interaction between variety and time of sowing were all significant for seed size in this trial (Table 3). TOS 3 had significantly higher 100 seed weight than TOS 1 and TOS 2.

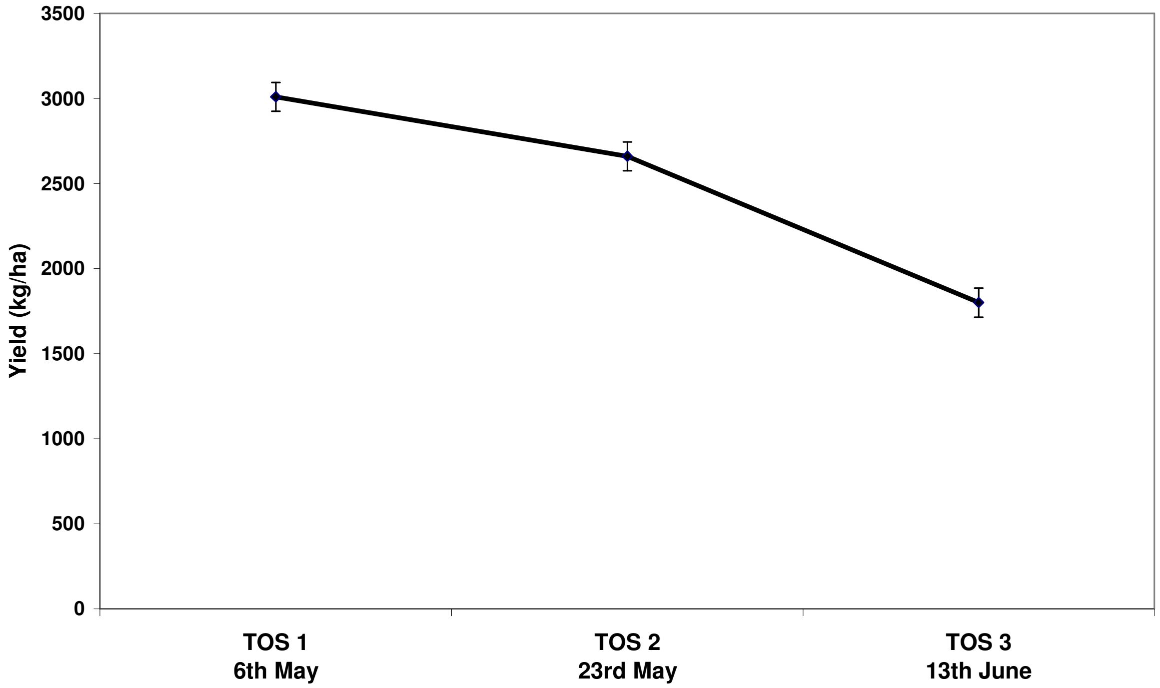


Figure TOS6: Yield response of chickpea to different sowing times at Cowra in 2008.

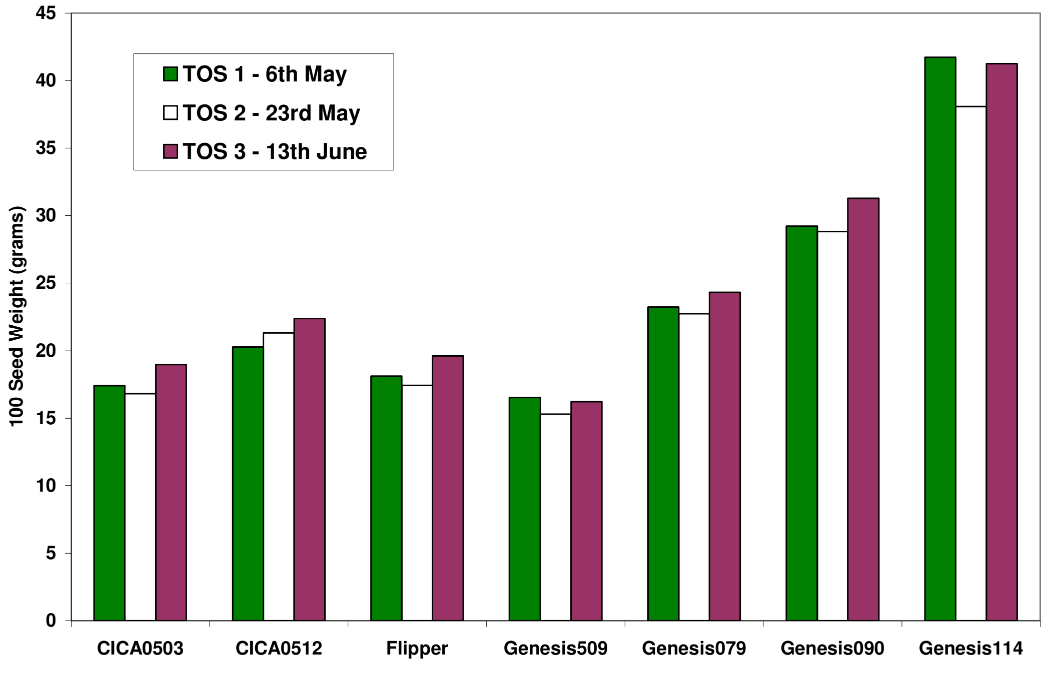


Figure TOS7: 100 seed weight response to variety and the effect of time of sowing (TOS) on variety response at Cowra in 2008.

Discussion

Plant establishment variations between varieties were due to the differing seed sources and the resulting differences in germination and seedling vigour. While plant populations varied, all were acceptable (with the exception of Genesis 114) and this should not have adversely affected yield. The significant variations in start of flowering is to be expected given the range of varieties tested and their different genetic backgrounds. While the different varieties were able to respond to the later sowing by shortening their time to flower, it was not sufficient for them to flower at the same time. An example being Genesis 509, that reduced days to flower from 127 days in TOS 1 to 108 days in TOS 3 still resulting in a 19 day difference. This meant that plants were flowering and then podding in less than ideal conditions.

Whilst the variations in end of flowering were significant, the range between varieties and sowing times was less than for the start of flowering dates. This indicates that seasonal conditions had a major influence on when the chickpea plants ceased flowering. It emphasizes the importance of ensuring a sufficient length of flowering to maximize yield. Figure 1 shows the importance of the relationship between flowering time and yield, for the 2008 season.

Despite seasonal conditions, TOS 1 out-yielded the later sowings due to more grain being set. Seed size variation between varieties corresponds to the differences between varieties normally recorded in trials across the region. The effect of sowing time on seed size is of interest, with seed size across many of the varieties increasing from TOS 1 to TOS 3. This may be reflecting the fact that the earlier sowing treatments had larger canopies and grain numbers, needing more water resources then were available to properly fill out the grain under the 2008 seasonal conditions.

Table TOS1: The effect of time of sowing (TOS) on establishment, flowering time and flowering duration for chickpea varieties at Cowra in 2008.

	Establishment (plants/m^2)			**Year day start 20% flower**			**Year day end 20% flower**			**Flower Duration (days)**		
	TOS			**TOS**			**TOS**			**TOS**		
Variety	1	2	3	1	2	3	1	2	3	1	2	3
CICA0503	28.1	26.1	31.8	254.7	260.6	271.9	302.2	301.6	302.6	41.0	40.9	30.7
CICA0512	25.3	28.8	24.1	257.4	263.0	271.9	300.9	302.4	303.6	36.8	39.3	31.4
Flipper	44.2	48.7	43.4	257.7	264.0	276.0	301.1	301.0	302.4	43.2	36.8	26.2
Genesis079	35.0	44.0	37.3	246.4	256.9	265.0	302.1	301.0	303.7	48.6	39.6	38.7
Genesis090	37.4	41.6	29.0	253.8	261.0	267.0	300.0	302.3	303.6	46.6	41.3	34.7
Genesis114	23.6	24.2	7.6	258.4	264.3	276.0	302.4	302.6	303.3	37.0	38.6	27.3
Genesis509	30.4	40.1	39.4	253.7	258.3	272.0	298.6	301.0	302.0	38.3	42.4	29.9
lsd	8.8			2.8			2.2			7.1		
Sow time	n/s			Sig	<0.001		Sig	<0.001		n/s		
Variety	Sig	<0.001		Sig	<0.001		Sig	<0.05		Sig	<0.001	
Sow time x Variety	Sig	<0.05		Sig	<0.001		Sig	<0.05		Sig	<0.05	

Table TOS2: The effect of time of sowing (TOS) on yield and 100 seed weight of chickpea varieties at Cowra in 2008.

	Mean grain yield (kg/ha) and rank						**100 Seed Wt (grams)**		
	TOS						**TOS**		
Variety	1 **6/05/08**		2 **23/05/08**		3 **13/06/08**		1	2	3
CICA0503	2970	5	2620	5	1760	5	17.4	16.8	18.9
CICA0512	2750	7	2400	7	1550	7	20.3	21.3	22.4
Flipper	2930	6	2580	6	1720	6	18.1	17.4	19.6
Genesis079	3350	1	3000	1	2150	1	23.2	22.7	24.3
Genesis090	3270	3	2920	3	2060	3	29.2	28.8	31.3
Genesis114	2440	8	2090	8	1230	8	41.7	38.1	41.3
Genesis509	3300	2	2950	2	2090	2	16.5	15.3	16.2
Mean	3011		2661		1804				
Trial mean	2492								
lsd							1.6		
Sow time	Sig	<0.001	170				Sig	<0.001	
Variety	Sig	<0.001	270				Sig	<0.001	
Sow time x Variety	n/s						Sig	<0.05	

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 Genesis 090 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 (Horsham), Victoria

Treatments

- Varieties (Genesis 090, Genesis 079, Genesis 114, Almaz, CICA0503 and Genesis 509)
- Treatments

Table 3.1. Fungicide treatments, rates and timings used at Horsham and Curyo to control ascochtya 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: No disease was present in the trial this year, therefore no effects of fungicide management regime were seen.
- Climate – see milestone 14
- All varieties produced similar yields in 2008 except Almaz which was approximately 0.1t/ha lower (Table 3.2).

Table 3.2. Grain yields of chickpea varieties in disease management trials at Horsham in 2008

Almaz	CICA0503	Genesis 079	Genesis 090	Genesis 114	Genesis 509
0.15	0.25	0.22	0.26	0.24	0.29

lsd - 0.03

TRIAL 2: Chickpea Disease Management, southern Mallee (Curyo), Victoria

Treatments

- Varieties (Genesis 090, Genesis 079, Genesis 114, Almaz, CICA0503 and Genesis 509)
- Treatments (see Table 3.1)

Results and Interpretation

- Key Message: No disease was present in the trial this year, therefore no effects of fungicide management regime were seen.
- Climate – see milestone 14
- Grain yields were double that observed at Horsham. CICA0503, Genesis 079 and Genesis 509 produced slightly higher yields than Genesis 090 and Genesis 114 and double that of Almaz (Table 3.3).

Table 3.3. Grain yields of chickpea varieties in disease management trials at Curyo in 2008

Almaz	CICA0503	Genesis 079	Genesis 090	Genesis 114	Genesis 509
0.24	0.51	0.50	0.44	0.41	0.51

lsd - 0.06

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.

TRIAL 1: Field Pea Plant Density, Wagga Wagga, New South Wales

Key Findings

- Increasing plant population increased grain yield up to 40 - 50 plants/m^2 for all varieties except SW Celine and Parafield. Yield of these continued to increase up to 60-70 plants/m^2.
- Earlier maturing varieties appear better positioned to respond to increasing plant density than later maturing varieties under harsh dry conditions

Trial Aim

To test yield responses of new varieties of field pea to increasing plant populations in southern NSW. The information from this trial plus many others is used to formulate grower recommendations.

Trial Details

Location: Wagga Wagga, NSW.
Soil type: Red Brown Earth.
Previous crop: Barley.
Treatments:

Field pea type	Varieties (6)
Dun	Kaspa, Yarrum, OZP0703, Parafield
White	SW Celine
Blue	OZP0704
Target Plant Populations	16, 32, 48, 64 & 80

Trial management:

This trial was sown on 23rd June into good moisture. Excellent establishment, weed control and insect control resulted.

Sowing rate	various
Row Spacing	30 cm
Sowing date	23rd June
Fertiliser	115 kg/ha Grain legume Super
Herbicide	23rd June - 2 l/ha Stomp + 1.6 l/ha Avadex xtra post sow pre emerge 70 g/ha Spinnaker
Insecticide	200 ml/ha Alpha-cypermethrin
Fungicide	Nil
Harvest date	18 November

Method
Plots were sown into moisture in a zero-tillage system using a cone-seeder on 30cm row spacing with Janke knife tynes. Press wheels directly followed the tynes to effect good seed-soil contact. Plots were grown according to standard management practices for field pea. Establishment counts were undertaken in early August when plants were at the 3-5 nodes.

Trial Results
Yield
Varieties yielded significantly different from each other, and there were significant responses to increasing seeding rate, but this response varied widely depending on variety (ie a significant Variety x Plant population interaction).

SW Celine and Parafield were significantly higher yielding than the other varieties.

Increasing seeding rate resulted in increased grain yield up to about 40-50 plants/sq m for most varieties although responses continued up to 60-70 plants/sq m for SW Celine and Parafield.

Discussion
SW Celine had the steepest response curve to increasing plant density, and this result was similar to 2007. It appears the earlier maturing varieties are better positioned to respond to increasing plant density than later maturing varieties under harsh dry conditions. Conversely, yield of later maturing varieties (Yarrum, Kaspa and OZP0704) in these same conditions tend to plateau at lower plant populations.

It is important to realize plant population responses vary from season to season and from variety to variety. It is best management practice to target densities above critical minimums (approximately 30 plants /m^2) to ensure good ground cover and a sufficient number of potential podding sites (flowers) to achieve acceptable yield levels. Seed germination, soil moisture and sowing techniques become critical.

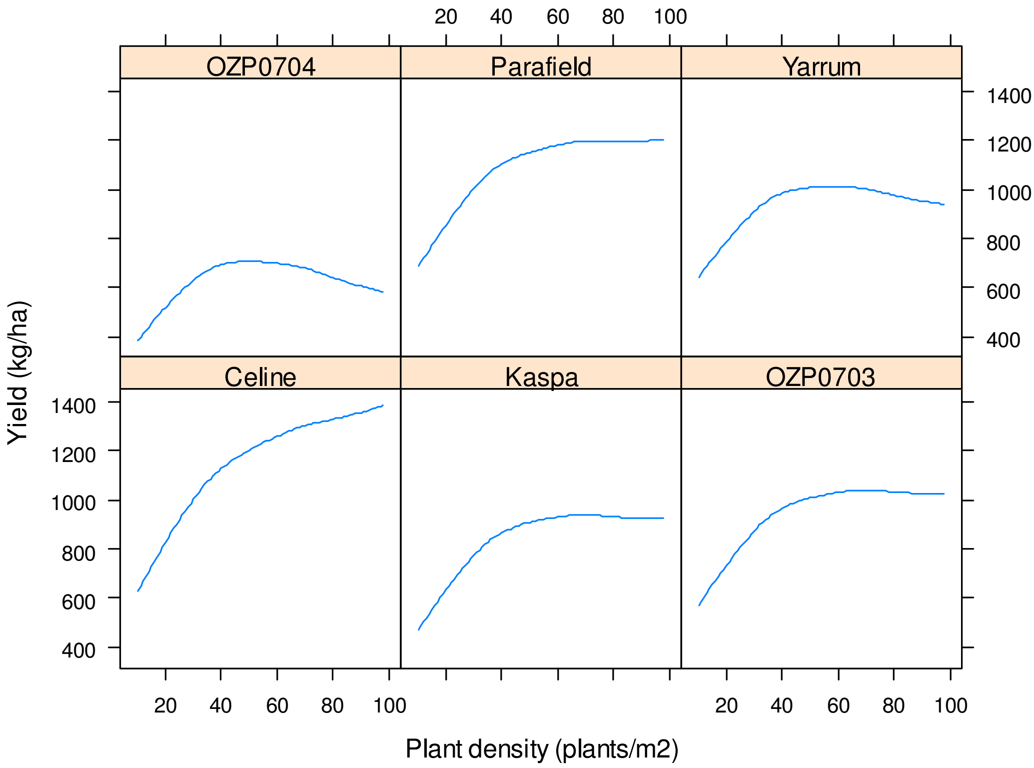


Figure FP1: Field pea variety response curves to changing plant populations at Wagga Wagga in

<u>TRIAL 2: Field Pea Plant Density, Yenda, New South Wales</u>

Key Findings

- Sturt was the highest yielding and most responsive to increasing seeding rate
- Kaspa and Yarrum showed a flat or negative response (similar to 2007), reflecting a combination of late flowering and dry warm conditions in September and October.

Trial Aim

To test yield responses of new varieties of field pea to increasing plant populations in southern NSW. The information from this trial plus many others is used to formulate grower recommendations.

Trial Details

Location: “Hillview” Yenda, NSW.
Soil type: Red Sandy Loam.
Previous crop: Barley, continuously cropped for 9 years.

Treatments:

Field pea type	Varieties (6)
Dun	Kaspa, Parafield, Yarrum, OZP0703
White	SW Celine, Sturt
Target Plant Populations	16, 32, 48, 64 & 80

Trial management:

This trial was sown on 17th June into good moisture. Excellent establishment, weed control and insect control resulted. Spray operations were carried out by the cooperating farmer using a 36m boom.

Sowing rate	various
Row Spacing	30 cm
Sowing date	17th June
Fertiliser	115 kg/ha Grain legume Super
Herbicide	Metribuzin 750g/kg 180g/ha on 25th June (PSPE) Select 300ml/ha on 28th August (grass control)
Insecticide	200 ml/ha Fastac (Alpha-cypermethrin) on 3rd October
Fungicide	Nil
Harvest date	26th November

Method

Plots were sown into moisture in a zero-tillage system using a cone-seeder on 30cm row spacing with Janke knife tynes. Press wheels directly followed the tynes to effect good seed-soil contact. Plots were grown according to standard management practices for field pea. Establishment counts were undertaken on the 12th August when plants were at the 3-5 node stage.

Trial Results
Yield
Varieties were significantly different from each other, and there were significant responses to increasing plant population, but this response varied widely depending on variety (ie a significant variety x plant population interaction).
Sturt was the highest yielding variety and the most responsive to increasing plant population. Its yield peaked at over 60 plants/m^2 (see Figure 1). .
Kaspa, Parafield and Yarrum were the least responsive, their yields peaking around 25-30 plants/m^2.

Discussion
While Sturt's high yield is consistent with previous findings in drier short-seasoned environments and consistent with our variety recommendations for this area, it is normally not as responsive to such high plant densities.
Interesting, Kaspa and Yarrum showed similar negative responses at Yenda in 2007, and this is probably more a reflection of their late flowering responding poorly to dry seasons.

It is important to realize plant population responses vary from season to season and from variety to variety. It is best management practice to target densities above critical minimums (approximately 30 plants /m^2) to ensure good ground cover and a sufficient number of potential podding sites (flowers) to achieve acceptable yield levels. Seed germination, soil moisture and sowing techniques become critical.

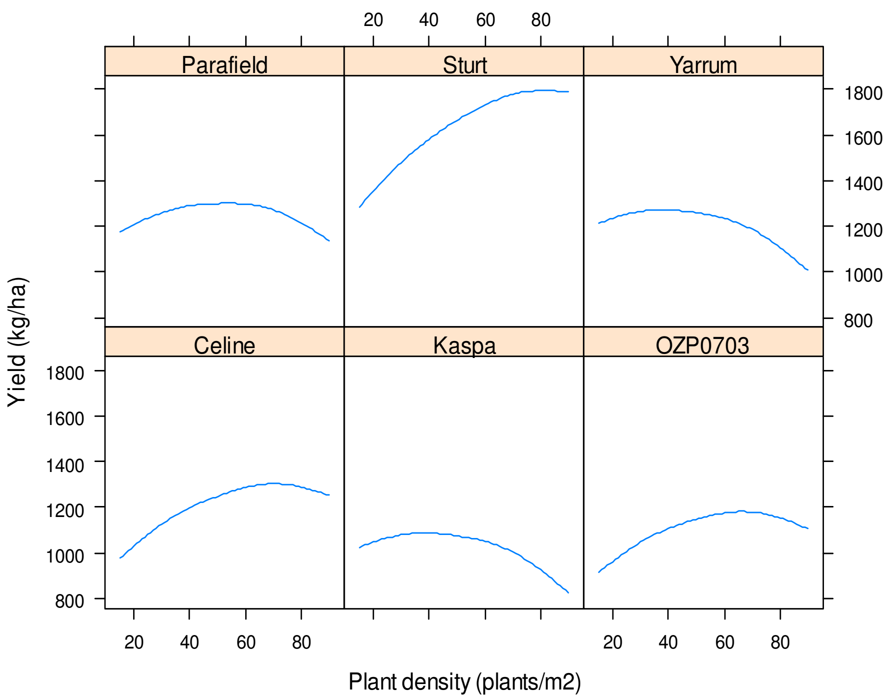


Figure FP2: Field pea variety response curves to changing plant populations at Yenda in 2008.

TRIAL 3: Field Pea Row Spacing, Wagga Wagga, New South Wales

Key Findings

- Increasing row spacing resulted in highly significant reductions in grain yield for all varieties
- Narrow rows were better placed to handle the harsh conditions in the 2008 season
- SW Celine was the highest yielding variety, followed by Parafield, OZP0703 and then Kaspa

Trial Aim

To investigate and model the effects of changing row spacing on field pea yield in southern NSW. The information from this trial plus others is used to validate and improve grower recommendations.
This issue has particular relevance in current farming systems dependant on direct seeding and stubble retention.

Trial Details

Location: Wagga Wagga, NSW
Soil type: Red brown earth
Previous crop: Barley.

Treatments:

Field pea types	Varieties
Short dun	Kaspa and OZP0703
Tall dun	Parafield
Short white	SW Celine
Row Spacing	20, 30,40 & 50 cm

Trial management:

Sowing rate	48 plants/m^2
Sowing date	26th June
Fertiliser	115kg/ha Grain Legume Super
Herbicide	26th June - 2 l/ha Stomp + 1.6 l/ha Avadex xtra post sow pre emerge 70 g/ha Spinnaker
Insecticide	200 ml/ha Alpha-cypermethrin
Harvest date	18 November

Method

Plots consisted of two adjacent runs of the cone-seeder to provide sufficient row numbers for the wider row spacing and to minimise edge effects. Therefore the number of rows sown per plot varied from 16, 12, 8 and 6 for the 20, 30, 40 & 50cm row spacing respectively. Accordingly, plot widths varied with each treatment.
Plots were directly sown into barley stubble using a cone-seeder with Janke knife tynes attached to an adjustable tool bar. Press wheels directly followed the tynes to effect good seed-soil contact.

Plots were grown according to standard management practices for field pea. Establishment counts were undertaken in early August when plants were at the 3-5 nodes. Six random counts were taken per plot, each along 80cms of row.

Trial Results
Yield
Increasing row spacing resulted in highly significant reductions in grain yield for all varieties tested (see Figure 1). Each variety responded similarly to changes in row spacing (ie no significant variety x row spacing interaction).

SW Celine was the highest yielding variety, followed by Parafield then OZP0703 and Kaspa (differences highly significant - P<0.001).

Discussion
With the dry seasonal conditions at Wagga Wagga in 2008, the narrowest row spacing (20cm) resulted in the highest yield. Under these restricted seasonal conditions, the narrow plant row spacings were better positioned to reach full ground cover and assist setting and filling as many of the available flowering sites as possible. Plant growth at wider row spacing was too restricted to be able to compensate sufficiently.

This scenario may have been different given a full profile of moisture which could have given the wider rows greater reserves of moisture to draw on. In this situation, the wider rows may have been in a better position than the narrower rows to cope with the unusually dry August, September and October.

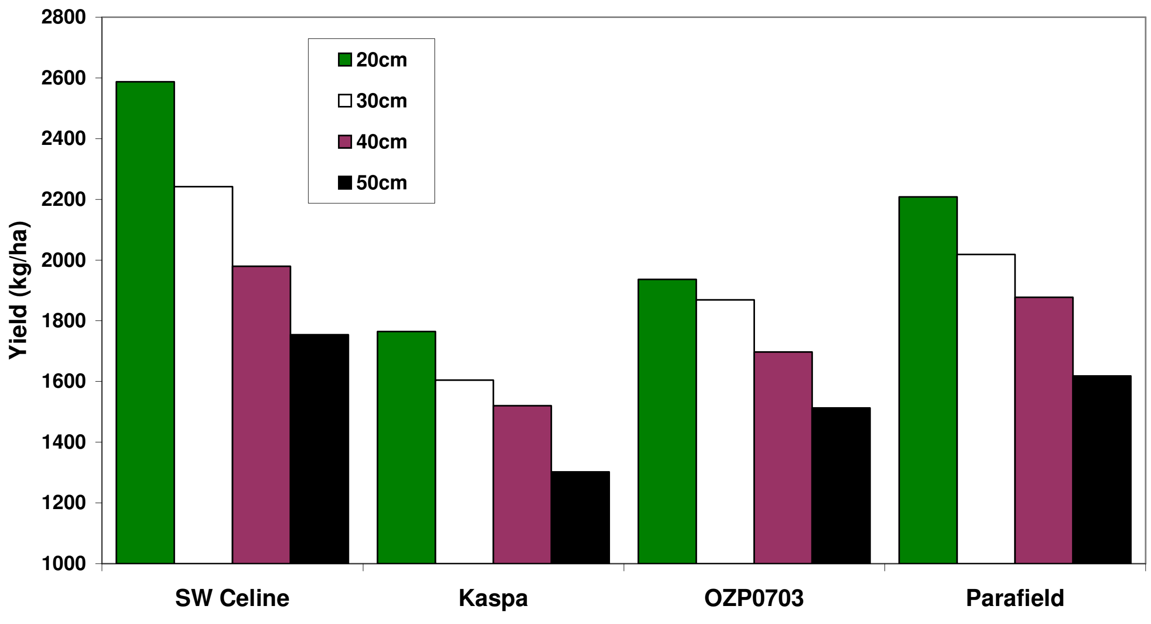


Figure FP4: Field pea yield response to variety and the effect of row spacing on yield at Wagga Wagga in 2008.

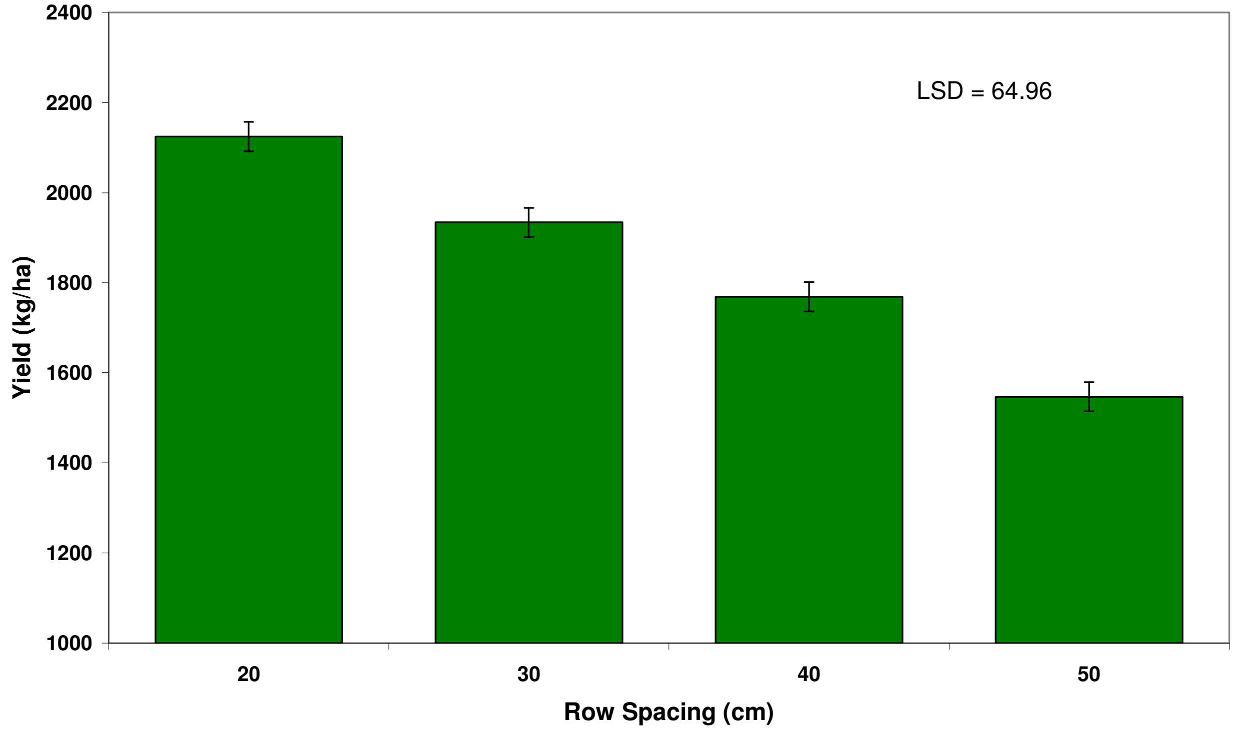


Figure FP3: Field peas yield responses to changes in row spacing at Wagga Wagga in 2008.

TRIAL 4: Field Pea Row Spacing, Yenda, New South Wales

Key Findings

- Increasing row spacing had no statistically significant effect on grain yield, although there was a tendency for yield to decline at wider rows.
- Plant lodging increased and ground cover decreased at wider row spacings.
- Sturt was the highest yielding variety.

Trial Aim

To investigate and model the effects of changing row spacing on field pea yield in southern NSW. The information from this trial plus others is used to validate and improve grower recommendations.
This issue has particular relevance in current farming systems dependant on direct seeding and stubble retention.

Trial Details

Location: “Hillview” Yenda, NSW
Soil type: Red Sandy Loam.
Previous crop: Barley, continuously cropped for 9 years.

Treatments:

Field pea types	Varieties
Short dun	Kaspa and OZP0703
Tall dun	Parafield
Short white	SW Celine
Row Spacing	20, 30,40 & 50 cm

Trial management:

Sowing rate	48 plants/m^2
Sowing date	19th June
Fertiliser	115kg/ha Grain Legume
Herbicide	Metribuzin 750g/kg 180g/ha on 25 June (PSPE). Select 300ml/ha on 28th August (grass control)
Insecticide	200 ml/ha Fastac (Alpha-cypermethrin) on 3rd October
Harvest date	26th November

Method

Plots consisted of two adjacent runs of the cone-seeder to provide sufficient row numbers for the wider row spacing and to minimise edge effects. Therefore the number of rows sown per plot varied from 16, 12, 8 and 6 for the 20, 30, 40 & 50cm row spacing respectively. Accordingly, plot widths varied with each treatment.
Plots were directly sown into barley stubble using a cone-seeder with Janke knife tynes attached to an adjustable tool bar. Press wheels directly followed the tynes to effect good seed-soil contact.
Plots were grown according to standard management practices for field pea. Establishment counts were undertaken in early August when plants were at the 3-5 nodes.

Trial Results
Yield
Increasing row spacing had no significant effect on grain yield across all varieties (P<0.05). However, there was a trend (P<0.10) for yield to decline at the wider row spacing (see Figure 1).

Sturt yielded significantly higher than all other varieties (P<0.01).

As row spacing increased, ground cover of all varieties at maturity declined from around 90% down to around 60%. Lodging of Kaspa and OZP0703 also increased at wider row spacing.

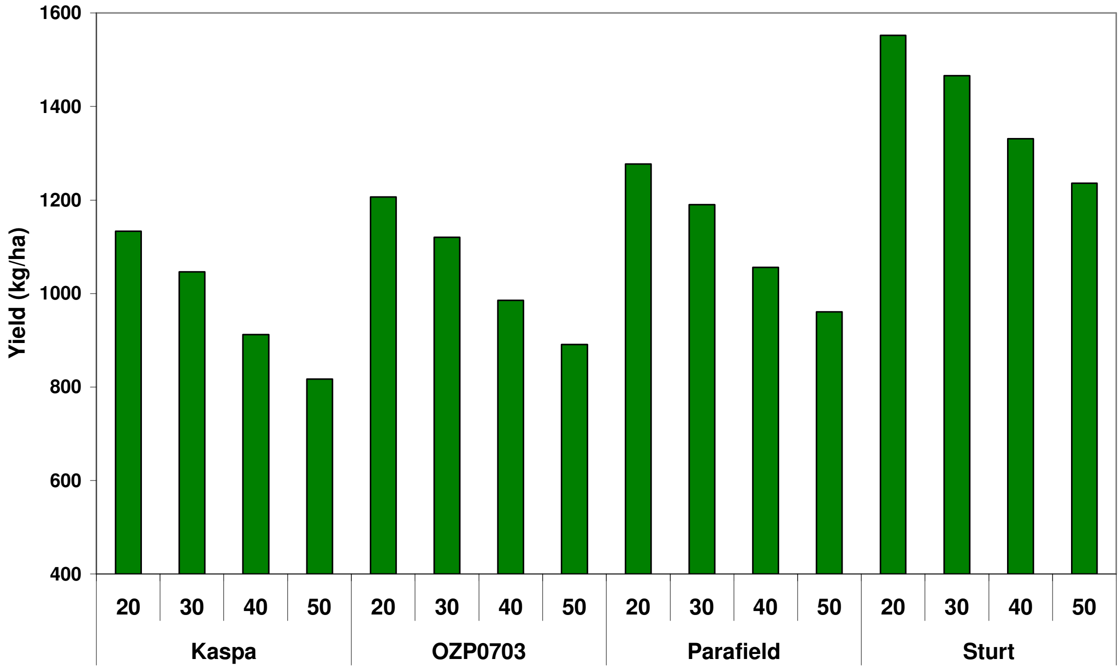


Figure FP5: Effects on yield of field pea from varying row spacing (cm) at Yenda in 2008.

Discussion

Narrower row spacing tends to be better suited to dry seasons, particularly with little or no sub soil moisture at the start of the season. A row spacing of 30 cm seems fine under most conditions.

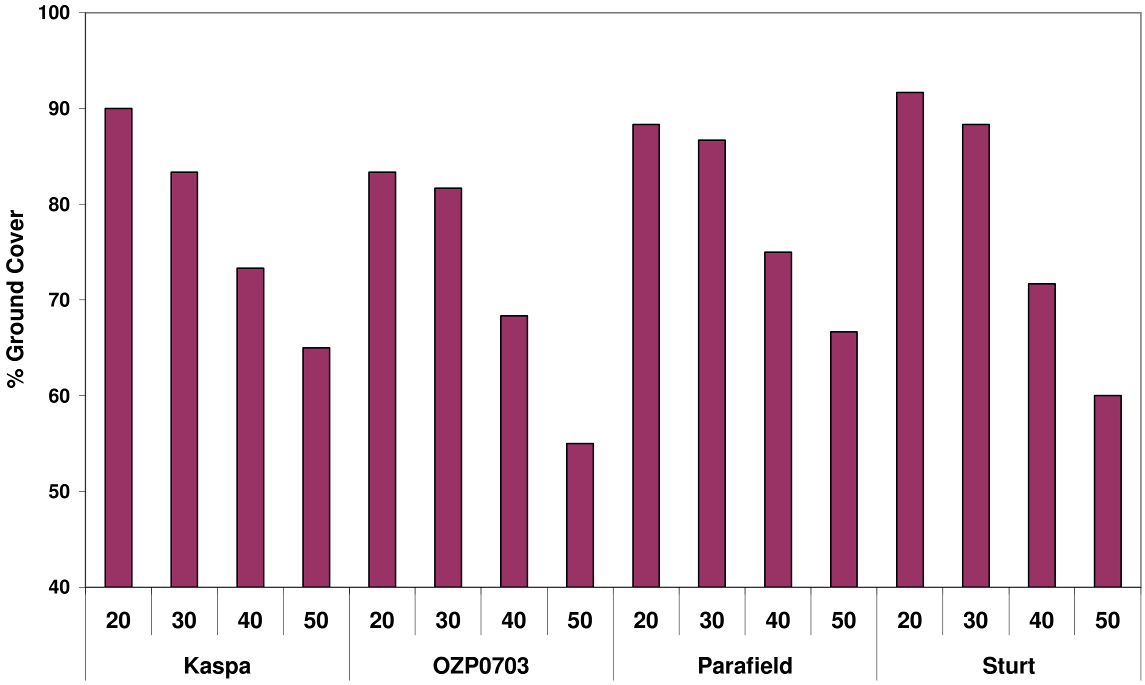


Figure FP6: Changes to ground cover of field pea varieties resulting from increased row spacing (cm) at Yenda in 2008.

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 (Genesis 090, Genesis 079, Genesis 114, Almaz, CICA0603 and CICA0503)
- 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 and PS, reduced yield significantly in all varieties. There appeared to be a trend toward greater yield loss in Genesis 079, Genesis 114 and Almaz, however this will need to be confirmed in seasons with greater rainfall and yield potential.
- Climate – See Milestone 2
- 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 + isoxaflutole applied PSPE at double rate and simazine + imazethapyr applied at both rates PSPE and PS (Table 6.2). The simazine + imazethapyr treatments were particularly notable later in the season when the plots were under stress, due to the dry conditions, causing stunting of growth.

- Weed populations – ryegrass was present at the site and relatively evenly distributed throughout the trials. It was controlled through applications of grass selective herbicide.
- Grain yield – grain yields were extremely low in 2008, generally being less than 0.4t/ha. Simazine + imazethapyr applied at the double rate PSPE and PS, reduced yield significantly in all varieties (Table 6.3). There appeared to be a trend toward greater yield loss in Genesis 079, Genesis 114 and Almaz, however this will need to be confirmed in seasons with greater rainfall and yield potential.

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 Horsham in 2008. As there were no differences in herbicide damage across varieties, it has be averaged for each herbicide treatment.

Herbicide Treatment	**Herbicide**	**Grain Yield (t/ha)**						
	Damage	**Almaz**	**CICA0503**	**CICA0603**	**Genesis079**	**Genesis090**	**Genesis114**	**Mean**
Trif, (1000), PS	1.0	0.06	0.19	0.29	0.18	0.18	0.22	0.19
Trif, (2000), PS	1.0	0.07	0.31	0.31	0.21	0.25	0.20	0.23
Meto, (1000), PS	1.0	0.06	0.17	0.28	0.24	0.23	0.23	0.20
Meto, (2000), PS	1.3	0.08	0.21	0.35	0.19	0.24	0.27	0.22
Metri, (280), PSPE	1.0	0.10	0.29	0.40	0.25	0.33	0.30	0.28
Metri, (560), PSPE	1.3	0.13	0.30	0.35	0.25	0.31	0.35	0.28
Sim, (1000), PSPE	1.0	0.11	0.31	0.30	0.27	0.32	0.29	0.27
Sim, (2000), PSPE	1.0	0.08	0.32	0.39	0.24	0.28	0.30	0.27
Sim + Diu, (800+450), PSPE	1.0	0.05	0.27	0.27	0.21	0.20	0.24	0.21
Sim + Diu, (1600+900), PSPE	1.0	0.17	0.40	0.38	0.27	0.31	0.34	0.31
Sim + Iso, (800+100), PSPE	1.0	0.13	0.28	0.41	0.28	0.34	0.28	0.28
Sim + Iso, (1600+200), PSPE	2.3	0.23	0.26	0.37	0.29	0.32	0.35	0.30
Sim + Iso, (1600+200), PS	1.0	0.14	0.28	0.32	0.25	0.30	0.22	0.25
Sim + Metri, (800+280), PSPE	1.0	0.06	0.24	0.28	0.23	0.28	0.25	0.23
Sim + Metri, (1600+560), PSPE	1.0	0.08	0.29	0.30	0.28	0.34	0.26	0.26
Sim + Ima, (800+45), PSPE	2.0	0.12	0.31	0.38	0.27	0.36	0.24	0.28
Sim + Ima, (1600+90), PSPE	5.3	0.00	0.08	0.10	0.03	0.09	0.02	0.05
Sim + Ima, (1600+90), PS	4.0	0.00	0.20	0.28	0.07	0.15	0.08	0.13
Flum (25), Peb	1.0	0.07	0.22	0.39	0.30	0.28	0.24	0.25
Flum (50), Peb	1.0	0.09	0.17	0.22	0.17	0.28	0.23	0.19
Mean		0.09	0.26	0.32	0.22	0.27	0.25	0.23

lsd (Herbicide damage) – 1.0; lsd (Grain Yield) – 0.1

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: Lentil Disease Management x Time of Sowing, Wimmera (Horsham), Victoria

Treatments

- Varieties (Nipper, Boomer, Nugget, Northfield, CIPAL411, CIPAL415)
- Sowing dates - 25 May, 1 July.
- Fungicide Treatments

Table 7.1. Fungicide treatments, rates and timings used at Horsham to control ascochyta blight (chlorothalonil) and botrytis grey mould (carbendazim)

Regime	Application Time
Nil	
Carbendazim 500 @ 500 ml/ha	Canopy closure
Chlorothalonil 500@ 2 L/ha	Podding
Carbendazim 500 @ 500 ml/ha then Chlorothalonil 500 @ 2 L/ha	Canopy closure then Podding

1. canopy closure sprays not applied this year as canopy closure not reached.

Results and interpretation

- Key Message: No disease was present in the trial this year, therefore no effects of fungicide management regime were seen. Grain yields ranged between 0.2 – 0.3 t/ha.

TRIAL 2 and 3: Lentil Disease Management x Time of Sowing, Kadina (Willamulka) & Maitland, Yorke Peninsula, SA

Aim

To maximise production advantages of new lentil varieties through the development of appropriate disease management strategies.

Treatments

Varieties:	Boomer, CIPAL411, CIPAL610, Nipper, Northfield, Nugget
Sowing dates:	Kadina – 6 May (Early), 23 May (Mid), 10 June (Late) Maitland - 13 May (Early), 2 June (Mid), 23 June (Late)
Fungicides:	Nil Canopy Closure - Carbendazim (0.5 L/ha) at canopy closure Climate - Carbendazim (0.5 L/ha) at or after canopy closure depending upon whether temperatures are conducive to disease development. Complete - Carbendazim (0.5 L/ha) at canopy closure + mid flower, Chlorothalonil at mid flower + mid podding
Fertiliser:	Kadina - MAP + Zn @ 75kg/ha at sowing Maitland - MAP + Zn @ 90kg/ha at sowing

Please Note: Dry seasonal conditions at Kadina suppressed plant growth and it was apparent early in the season disease development would not occur, consequently this experiment was changed in favour of a Sowing Time x Crop-topping / Delayed Harvest trial (See next report).

Trial 1: Maitland

Results and Interpretation

Grain yield

Mid-sown (May 27) lentils performed best at Maitland (averaging 2.6t/ha) followed generally by early (May 6) then late sown (June 17), however varieties behaved differently (Figure 1a). CIPAL411 was the highest or equal highest yielding line at each sowing time. CIPAL411, Nipper and Northfield all maximized yield at early sowing times, however yield penalties occurred at the early sowing times for Boomer, CIPAL610 and Nugget (Figure 1a).

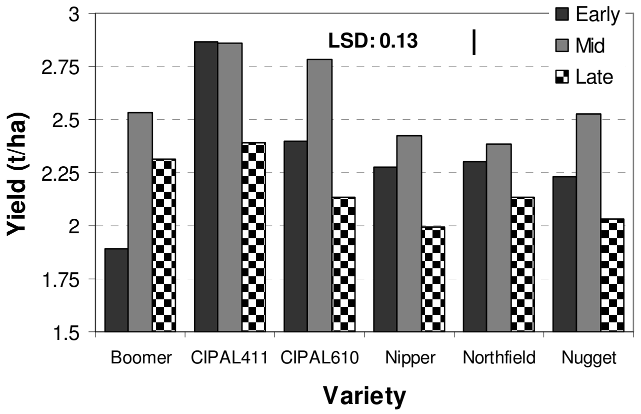


Figure 1a: Effect of sowing time on yield of six lentil varieties at Maitland, 2008.

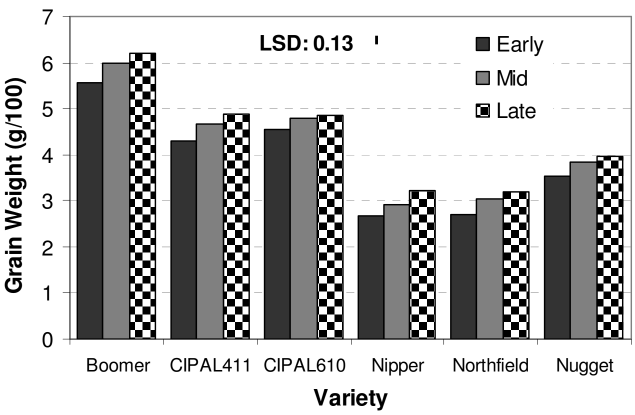


Figure 1b: Effect of sowing time on grain weight of six lentil varieties at Maitland, 2008.

These observed yield losses in Boomer and CIPAL610 (early flowering varieties) are most likely due to a combination of their flowering and early pod set occurring in periods of cold temperatures and that they produce relatively high biomass levels increasing their risk of "haying-off" under the dry spring conditions which prevailed. The yield penalty observed in Nugget is most likely due to its relative later maturity and high biomass production.

Grain weight

A general trend of increased grain weight was found as sowing time was delayed (Figure 1b), however CIPAL610 and Nugget showed no difference between the mid and late sowing times. Boomer had the highest grain weight, followed by CIPAL411 and CIPAL610, which were similar in size. Nipper and Northfield had similar and lighter grain weights.

Biomass

Early sown lentils generally produced more biomass, followed by mid then late sowings (Figure 2), though there was no difference between sowing times in some varieties. CIPAL411, CIPAL610, Boomer and Northfield produced most biomass sown early, and Boomer and Northfield at the mid sowing time, but there was no varietal difference in biomass when sown late.

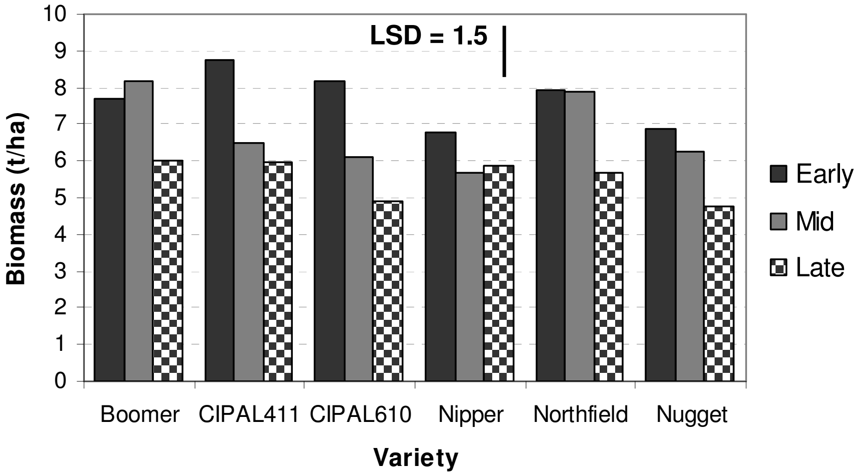


Figure 2: Effect of sowing time on biomass of six lentil varieties at Maitland, 2008.
Note: some leaf loss was observed in Boomer and CIPAL610 in Early treatment.

Lodging

Lodging was lower at the late sowing time in all varieties (Figure 3). CIPAL411 and 610 had higher levels at the early sowing date than at the mid, but all other varieties performed similarly between the early and mid sowing dates. Boomer was more prone to lodging at all sowing dates.

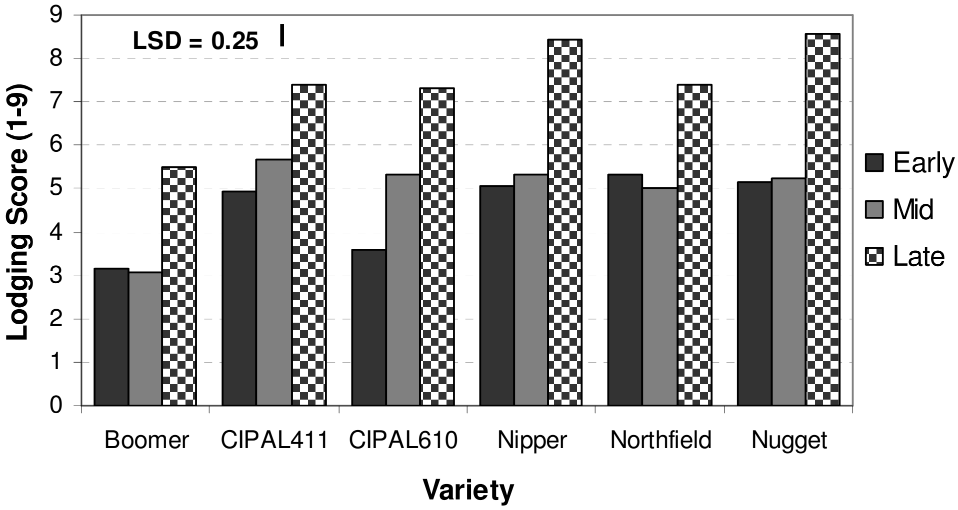


Figure 3: Effect of sowing time on lodging of six lentil varieties at Maitland, 2008.
N.B. 1 = flat and 9 = upright.

Pod drop and Shattering

Total grain losses (combination of pod drop and shattering) (Table 1) were very low compared to total achieved grain yield (Figure 1a), and had no effect on relative variety performance, although varietal differences were still observed.

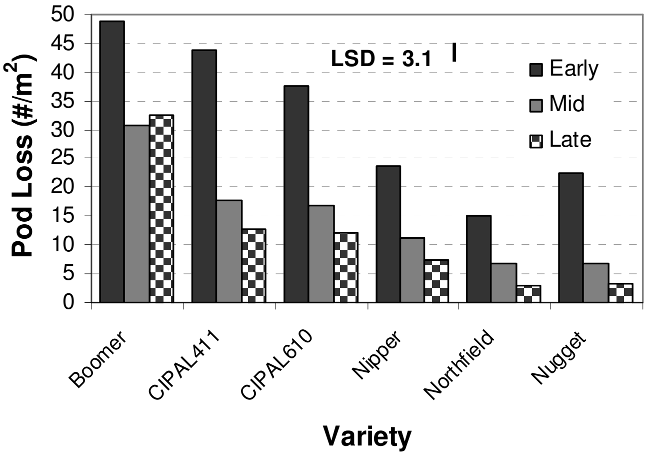
Pod drop estimates were consistently greater in the early sown lentils (Figure 4a), followed generally by mid then late sowings (exception being Boomer which showed no difference between mid and late). In addition, Boomer was consistently greater at all sowing times. However, since these early pod losses arise from relatively late harvest in Boomer, they could be minimised by appropriate harvest timeliness in this variety.

Grain losses through shattering were very low and minimal variety differences occurred (Figure 4b). Previous work has shown Boomer is more susceptible to shattering than other varieties.

Table 1: Total grain loss (t/ha) (pod drop and shattering) of 6 lentil varieties at 3 sowing times, Maitland 2008

Sowing Time	Total Grain Loss (t/ha)					
	Boomer	**CIPAL411**	**CIPAL610**	**Nipper**	**Northfield**	**Nugget**
Early	0.069	0.042	0.038	0.013	0.008	0.017
Mid	0.049	0.018	0.018	0.007	0.004	0.005
Late	0.047	0.013	0.012	0.005	0.002	0.003

LSD (P<0.05) = 0.003



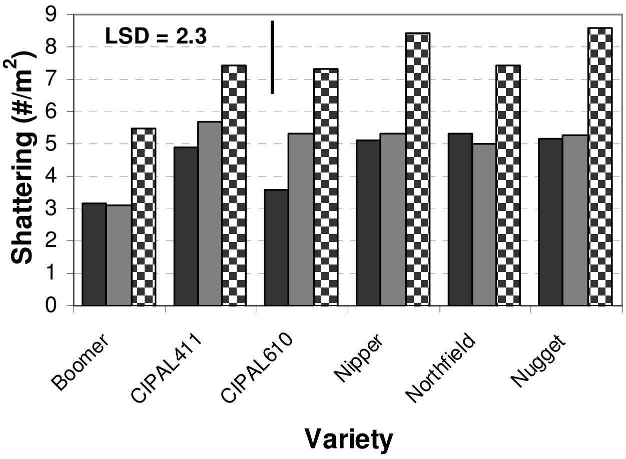


Figure 4a(L): Effect of sowing time on pod drop of six lentil varieties at Maitland, 2008.
Figure 4b(R): Effect of sowing time on shattering of six lentil varieties at Maitland, 2008.

Key Findings and Comments

- Boomer has been found to be not as well suited to early sowing times as other lentil varieties (eg Nipper) suffering yield losses from early sowing in 2008. This was most likely due to a combination of early flowering and high biomass production increasing the risk of it "haying-off" or incurring premature lodging. This yield reduction in Boomer is further compounded by a decrease in grain weight (important in green lentils), increased shattering at maturity and increased ascochyta blight seed blemish also prone to occur with earlier sowing times (as shown by previous research).

- By contrast, Nipper is better suited to early sowing times as its advantage arises from its dual ascochyta blight and botrytis grey mould disease resistance and short plant type reducing disease, lodging and haying off risks, particularly in lentil growing regions with medium to higher rainfall.

- CIPAL411 is a mid flowering line with early maturity. It was better suited to early sowing times in 2008 than other varieties. CIPAL610 is a very early flowering and maturing line and like Boomer incurred a yield penalty at Maitland at the early sowing time. Further validation of optimum sowing times for these new lines is required but initial findings suggest that CIPAL610 can be sown too early in SA. Conversely it is likely to be the best suited variety to dry seasons or late sowing times. CIPAL610 is also likely to be well suited to the agronomic practice of crop topping.

- As in previous years, grain weights increased with delayed sowing, and biomass production was minimised, causing less lodging.

- Grain loss was minimised by delayed sowing. Boomer generally incurred greater levels of grain loss than other varieties and timely harvest is essential in this variety.

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

2. Kadina trial – sowing time x desiccation management

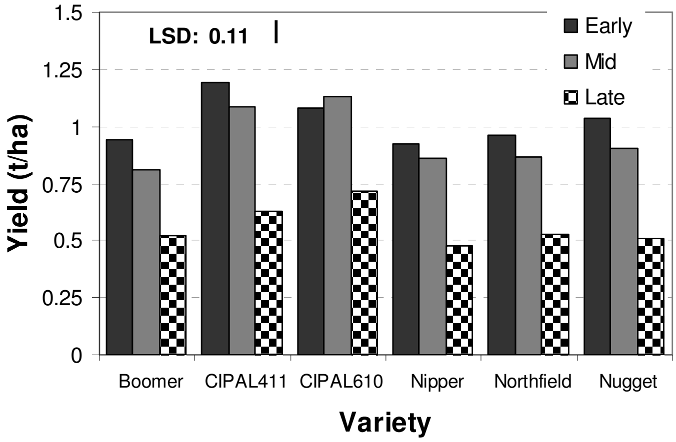
Aim
To maximise production advantages of new lentil varieties through the development of appropriate crop-topping and desiccation management strategies.

Treatments

Varieties:	Boomer, CIPAL411, CIPAL610, Nipper, Northfield, Nugget
Sowing dates:	6 May (Early), 23 May (Mid), 10 June (Late)
Treatments:	Nil
	Early crop top – timed to coincide with ryegrass milky dough stage
	Late crop top – 8 days after early timing
	Delayed harvest – harvest 14 days after the nil treatment for each sow date
	Fertiliser: MAP + Zn @ 75kg/ha at sowing

Grain yield
Grain yields generally decreased as sowing date was delayed, except for CIPAL610 and Northfield which yielded similarly at the early and mid sowing times (Figure 1a). A large yield decrease occurred in all varieties at the late sowing time (40% less than mid sown, compared with only a 16% reduction at Maitland). The earlier maturing varieties CIPAL411 and CIPAL610 had the highest grain yields at each sowing time.
Early crop-topping (performed at timing for optimum ryegrass control- milky dough stage) decreased yields, particularly at the late sowing time (Figure 1b). Nugget (latest maturing) was most affected by the early crop top treatment with a 25% yield reduction, while CIPAL610 (early maturing) was the only variety to show no yield reduction compared to the nil (Figure 2). The late crop topping timing (delayed 8 days after ideal timing) did not reduce lentil yield.

Delaying harvest by 14 days reduced harvested grain yield compared to the nil (timely harvest), averaging 85% of the nil yield (Figure 1b). Boomer was the most severely penalised by delaying harvest (47% yield loss) (pod loss data not shown), while Northfield and CIPAL610 were least affected (5% and 9% yield losses) (Figure 2).



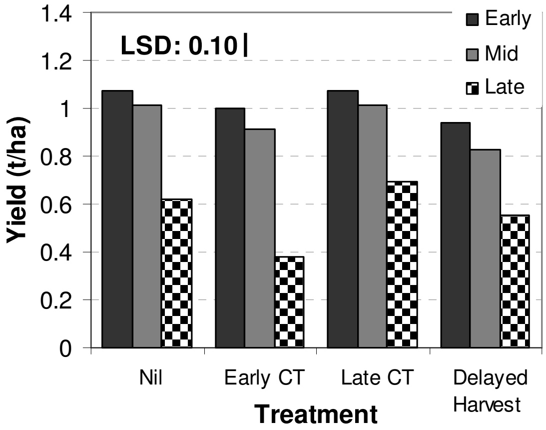


Figure 1a(L): Effect of sowing time on yield of six lentil varieties at Kadina, 2008.
Figure 1b(R): Effect of sowing time and management on yield of lentils at Kadina, 2008.

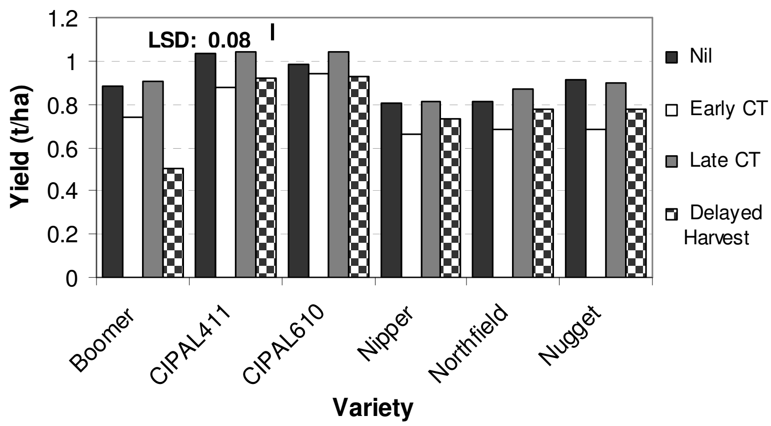
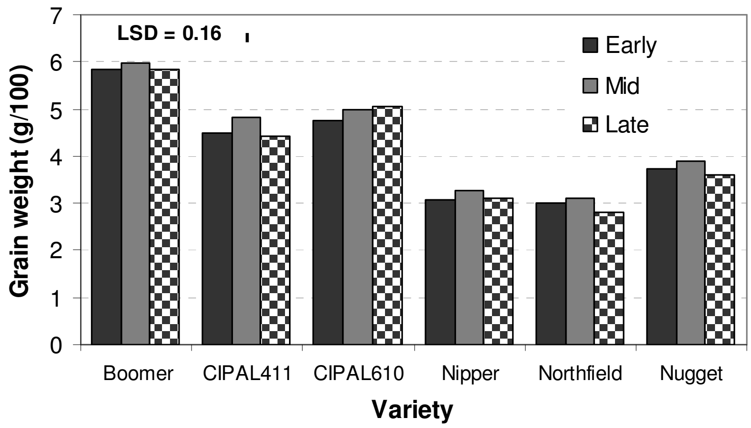


Figure 2: Effect of sowing time and management on yield of lentils, Kadina 2008

Grain Weights
In contrast to the trend observed at Maitland, grain weights at Kadina generally show a flatter response to sowing time (Figure 3a). At each sowing time grain weight, as for grain yield, was reduced by the early crop top treatment, with the largest reduction occurring at the late sowing time (Figure 3b). This was consistent across all varieties although the reduction was least in CIPAL610

(Figure 4). The late crop topping timing did not reduce lentil grain weight in any sowing time treatment, unlike the early crop topping timing at the late sowing time.



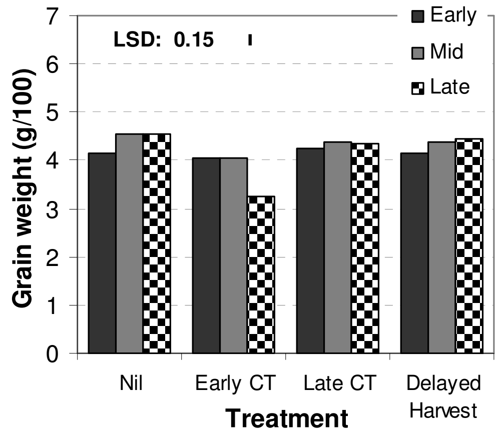


Figure 3a(L): Effect of sowing time on grain weight of four lentil varieties at Kadina, 2008.
Figure 3b(R): Effect of sowing time and management on grain weight of lentils at Kadina, 2008.

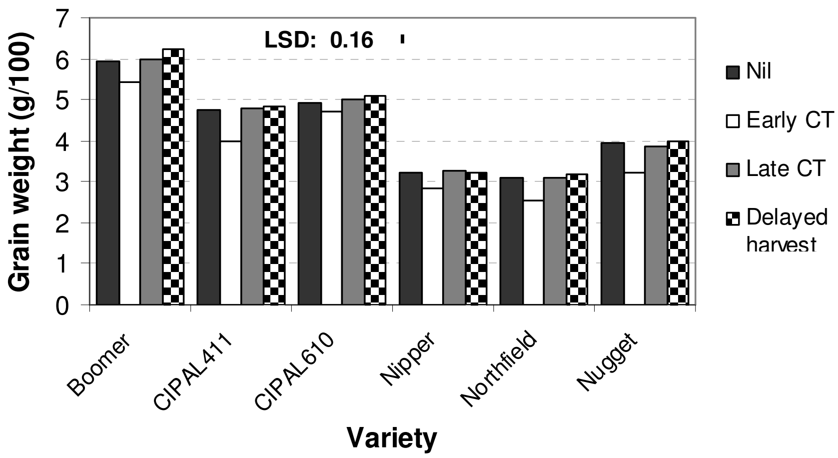


Figure 4: Effect of sowing time and management on grain weight of lentils, Kadina 2008.

Biomass
Biomass generally decreased as sowing time was delayed, however CIPAL411, Nipper and Northfield all showed small increases in biomass at the mid sowing time compared to the early sowing time (Figure 5). Boomer's biomass was highest at the early sowing time while CIPAL411 and Northfield were highest at the mid sowing. All varieties had relatively similar biomass sown late.

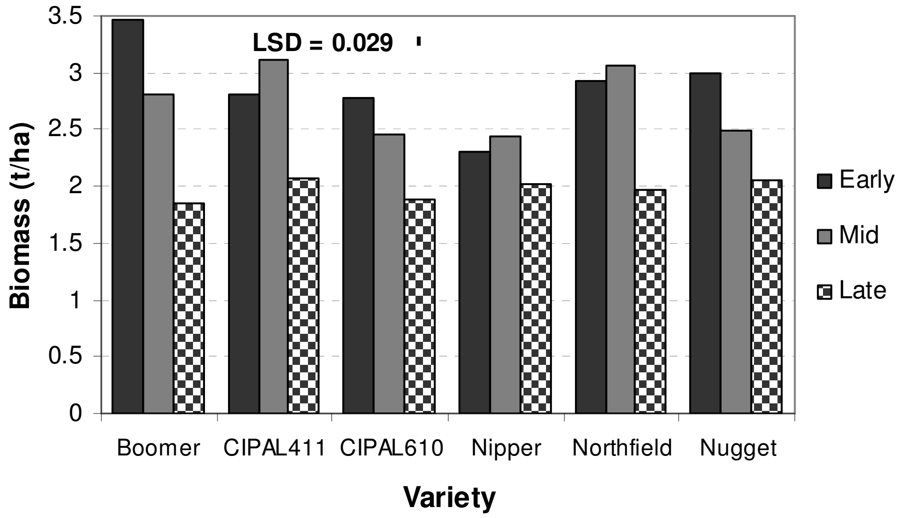


Figure 5: Effect of management on biomass of six lentil varieties at Kadina, 2008.

Key Findings and Comments

- Dry spring conditions suppressed grain yields and grain weights, especially at the late sowing time. Lentils generally benefited from the earlier sowing date although variety choice was important as early flowering varieties failed to set some early flowers and pods due to low temperatures at flowering time (particularly at the early sowing date).
- Yields and grain weights were reduced by the early crop-top and delayed harvest treatments, however the early maturing CIPAL610 was not affected, indicating it will have better suitability to this practice than other varieties.
- The late crop-topping treatment (past ideal rye grass control stage) did not generally affect yield or grain weight in any variety in 2008.
- CIPAL411 was highest, or equal highest yielding line along with CIPAL610, at each sowing time and is likely to be well suited to lentil growing districts which have a relatively short growing season. It appears better suited to earlier sowing dates than Boomer, Nugget and CIPAL610 providing disease can be managed.
- Delayed harvest trials confirmed Boomer's greater susceptibility to pod loss and shattering, and therefore appropriate harvest timeliness is essential when growing this variety. In contrast to expectations, the early maturing line CIPAL610 was not sensitive to pod loss, with yield losses similar to mid maturing varieties Northfield and Nipper.

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.

TRIAL 1: Faba Bean Plant Density, Wagga Wagga, New South Wales

Key Findings

- All varieties had the same yield response to increasing plant population.
- Yield significantly increased as plant population increased across the tested range.

Trial Aim

To test the yield response of new varieties of faba beans to changes in plant populations across southern NSW. The information from this trial plus others is used to validate and improve grower recommendations.

Trial Details

Location: Wagga Wagga, NSW.

Soil type: *Red Brown Earth.*

Previous crop: Barley.

Treatments:

Varieties	Farah, Nura 1269*483/6, 974*(611*974)/15
Target Plant Populations	10, 15, 20, 25, 30 & 35

Trial management:

Sowing rate	various
Row Spacing	30 cm
Sowing date	14th May
Fertiliser	115 kg/ha Grain legume Super
Herbicide	14th May - 2 l/ha Stomp + 1.6 l/ha Avadex xtra 26th May - 500 ml/ha Sencor 480
Insecticide	26th May - 100 ml/ha Lemat 200 ml/ha Alpha-cypermethrin
Fungicide	1.5 l/ha Pencozeb
Harvest date	13th November

Method

The trial was sown into moisture in a zero-tillage system using a cone-seeder on 30cm row spacing with Janke knife tynes. Press wheels directly followed the tynes to maximise seed-soil contact at the rear of the machine.

Trial Results

Yield

All varieties had the same yield response to varying plant population over the range tested, so there was no interaction by variety to plant population changes. There was however a significant response for both variety and plant population separately.

Discussion

Varietal yield differences seen in the trial are expected and reflect those from varietial comparisons that have been conducted across the region for variety evaluation and breeding selection purposes. The 2008 variety response was directly related to the varieities flowering time and maturity with those varieties that flowered earlier, but with a longer maturity able to capture late season rainfall. There was no variety by genotype interaction in this trial, with all varieties reacting the same to increasing plant population, this agrees with previous research conducted that showed all varieties responded similarly.

The response to plant population was significant in 2008, with yield increasing as plant population was increased across the tested range. This response is not unexpected in dryland situations where moisture stress is imposed on the crop, reducing the plants ability to compensate for less plant numbers by branching or flowering over an extended period.

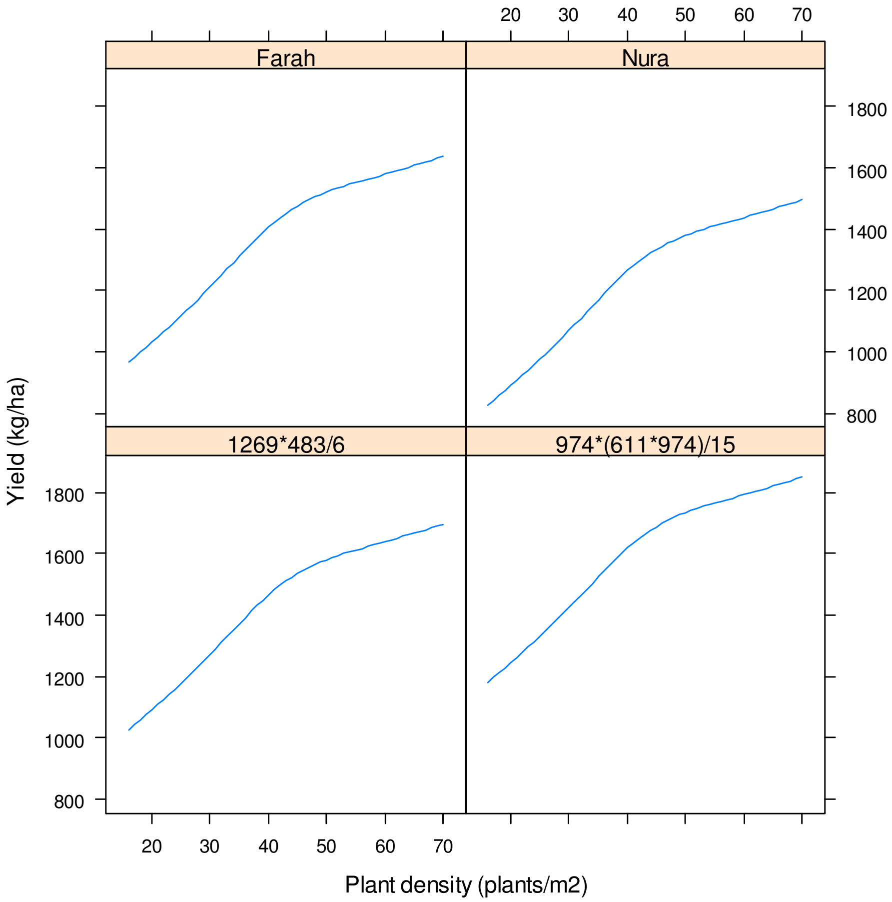


Figure FB1: Faba bean variety response curves to changing plant populations at Wagga Wagga in 2008.

TRIAL 2: Faba Bean Plant Density, Coleambally, New South Wales

Key Findings

- Yield significantly increased as faba bean plant population increased across the tested range.
- The faba bean variety, Farah, was the most responsive to increasing plant density under the irrigated conditions in 2008.

Trial Aim

To test the yield response of new varieties of faba beans to changes in plant populations under irrigated conditions in southern NSW. The information from this trial plus others is used to validate and improve grower recommendations.

Trial Details

Location: *Coleambally, NSW.*
Soil type: *Grey Clay.*
Previous crop: *Wheat.*

Treatments:

Varieties	Farah, Nura 1269*483/6, 974*(611*974)/15
Target Plant Populations	10, 15, 20, 25, 30 & 35

Trial management:

Sowing rate	various
Row Spacing	91.5 cm (2 rows to a 1.83 m permanent raised bed)
Sowing date	15th May
Fertiliser	600 kg/ha Bio Ag Phos-Lime 40/60 split 350 kg/ha Single Super 120 kg/ha Grain legume Super at sowing
Irrigation Schedule	20th April pre water ML/ha Spring irrigation: 1st - 1 ML/ha 2nd - 0.8 ML/ha 3rd - 0.8 ML/ha 4th - 0.9 ML/ha
Herbicide	25th July - Verdict 19th August - 1.2 l/ha Round Up Max by shielded sprayer
Insecticide	15th October - 400 ml/ha Dominex
Fungicide	25th July - 2 kg/ha Diathain 11th September - 2 kg/ha Diathain 15 October - 500 ml/ha Spinflow
Harvest date	4th December

Trial Results

Yield

There was a significant effect of plant density on all the faba bean varieties (P<0.01), with each having a linear response to increasing plant density at the tested plant populations, under irrigation in 2008. The interaction between variety and plant density was also significant (P<0.01). The variety effect was also highly significant at this site (P<0.001).

Discussion

All varieties showed a linear response to increasing plant density under irrigation in 2008, with Farah being the most responsive over the tested range.

Varietal yield differences seen in the trial are expected and reflect those from varietial comparisons that have been conducted across the region for variety evaluation and breeding selection purposes. Whilst irrigation has removed the issue of water stress, high temperatures still impacted on the trial with temperatures across the region higher than average for the late spring period. Days above 30'C would have halted flowering and pod set, restricting the yield of the late flowering/maturing varieties.

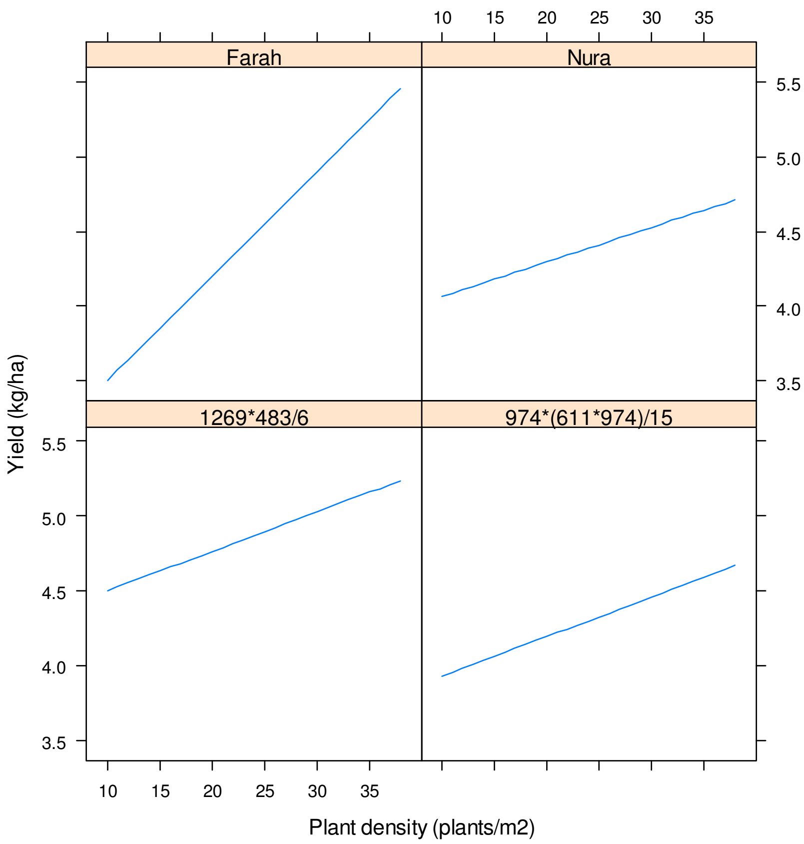


Figure FB2: Faba bean variety response curves to changing plant populations at Coleambally in 2008.

TRIAL 2: Faba Bean Row Spacing, Coleambally, New South Wales

Trial Aim

To investigate and model the effects of changing row spacing on faba bean yield in southern NSW. The information from this trial plus others is used to validate and improve grower recommendations.

Trial Details

Location: *Wagga Wagga, NSW.*
Soil type: Red Brown Earth.
Previous crop: *Barley.*

Treatments:

Varieties	Farah, Nura 1269*483/6, 974*(611*974)/15
Row Spacing	20, 30,40 & 50 cm

Trial management:

Target plant population	30 plants/m^2
Row Spacing	various
Sowing date	14th May
Fertiliser	115 kg/ha Grain legume Super
Herbicide	14th May - 2 l/ha Stomp + 1.6 l/ha Avadex xtra 26th May - 500 ml/ha Sencor 480
Insecticide	26th May - 100 ml/ha Lemat 200 ml/ha Alpha-cypermethrin
Fungicide	1.5 l/ha Pencozeb
Harvest date	13th November

Method

The trial was sown into moisture in a zero-tillage system using a cone-seeder on 30cm row spacing with Janke knife tynes. Press wheels directly followed the tynes to maximise seed-soil contact at the rear of the machine.

Trial Results

Yield

Both variety ($P<0.01$) and row space ($P<0.001$) effects were significant. The interaction of row space by variety was not significant at the 5% level.

Table FB1: Varietial yield responses in the row spacing trial at Wagga in 2008

Variety	Yield (kg/ha)
Farah	1229
Nura	962
1268*483/6	1309
974*(611*974)/15	1344
LSD 5%	62.1

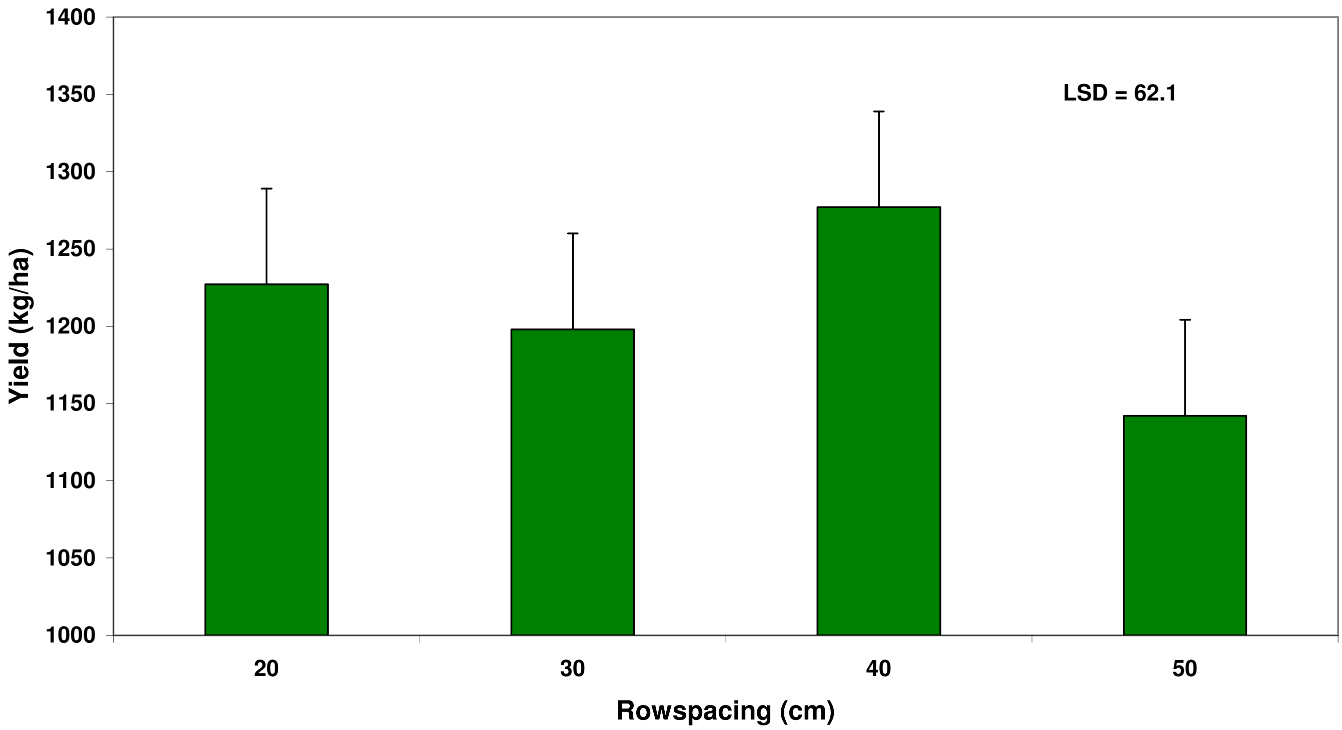


Figure FB3: Yield responses of faba bean to different plant row spacing at Wagga Wagga in 2008.

Discussion

The results in 2008 provided no clear guidance to the appropriate row spacing for faba beans. Whilst 40 cm row spacing provided the highest yield, it was not significantly different to the 20 cm treatment. 50 cm was the lowest yielding treatment, however this was not significantly different to the 30 cm row spacing treatment.

The varietal response at the site indicates the strong influence the 2008 climatic conditions had with the earlier flowering but later maturing lines doing better then the quicker shorter maturity lines, such as Farah. The later maturing lines being able to benefit from the later spring rainfall to help fill pods.

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 Disease Management x Time of Sowing, Tarlee, Mid North, SA

Aim

To maximise production advantages of new faba bean varieties through the development of appropriate disease management strategies.

Treatments

Varieties: Nura, Farah, 1269*483/6-1, 974*(611*974)/15-1

Sowing dates: 2 May (Early), 23 May (Late)

Treatments: Control = No fungicide

Teb/manc = Tebuconazole 8 wks post sowing + mancozeb late flower

Single carb = carbendazim at early flower

Double carb = carbendazim at early flower + late flower

Teb/2 carb = Tebuconazole 8 wks post-sow + carbendazim early & late flower

Complete = Tebuconazole & Chlorothalonil 8wks post sowing + chlorothalonil fortnightly thereafter with carbendazim during flowering

- Tebuconazole (430g/L a.i.) @ 145ml/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

Disease:

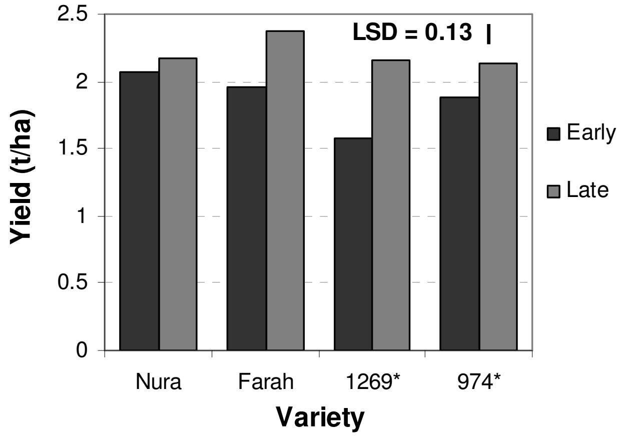
Only a low level of ascochyta blight and no chocolate spot disease infection occurred due to the short and dry spring which prevailed in 2008. The early sowing time of the beans had slightly higher levels of ascochyta blight infection than the later sown beans (Table 1). Neither treatment nor variety was significant in reducing disease infection and there was no effect of fungicide treatment on grain yield.

Table 1: The effect of sowing time on ascochyta blight severity in Faba beans, Tarlee 2008

Sowing Time	Early	Late	LSD
Ascochyta severity (# lesions/plant)	12.6	7.5	4.3

Grain yield

Higher grain yields were achieved as sowing date was delayed from early May to late May in 2008. Nura was the only variety not to incur a yield penalty from being sown in early May with similar grain yields achieved at both sowing dates (Figure 1a). Winter conditions were favourable for plant growth and high levels of biomass were produced, particularly in the early sowing treatment. A combination of increased levels of “haying off” caused by high biomass levels and the dry spring conditions and poor pod set in the dense bulky canopies of the early sown treatments were most likely the reason for lower yields in three of the four varieties at the early sowing date. Nura, which was shorter in plant height (particularly at the early sowing date) (see Figure 2a) was not as severely affected as the three taller varieites. Nura had the highest grain yields when sown early, but Farah had the highest yields when sown late.



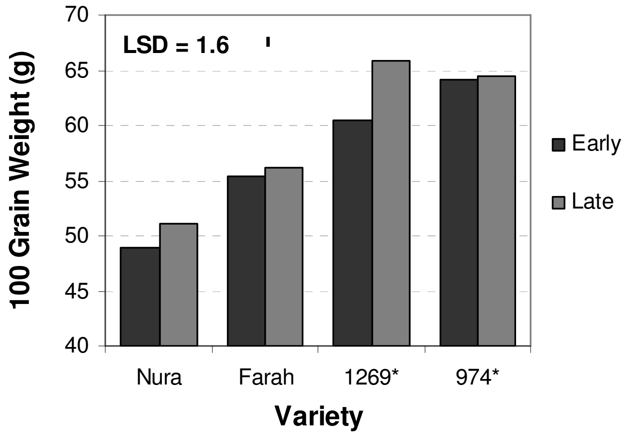


Figure 1a(L): The effect of sowing time on yield of four bean varieties, Tarlee 2008.
Figure 1b(R): The effect of sowing time on grain weight of four bean varieties, Tarlee 2008.

Grain Weight

Grain weights of Nura and 1269* increased as sowing date was delayed, but Farah and 974* were not significantly different (Figure 1b). Nura had the lowest grain weights at both sowing time while 974* had the highest when sown early and 1269* the highest when sown late.

Lodging & Necking

Scores taken at harvest showed that lodging and necking occurred only at low levels in the 2008 trial. Both traits were reduced by delaying sowing (Table 2). Nura, 1269* and 974* showed similar scores for lodging and necking, while Farah was consistently worse. This result for necking was different to that found at Tarlee in 2007 where Nura had higher levels than Farah.

Table 2: The effect of sowing time and variety on lodging and necking of beans, Tarlee 2008

.	Sowing Time			Variety				
	Early	Late	LSD (0.05)	Nura	Farah	1269*	974*	LSD (0.05)
Lodging*	7.8	8.5	0.36	8.7	7.2	8.3	8.4	0.41
Necking**	1.4	0.7	0.30	0.5	2.4	0.7	0.6	0.52

* Lodging score – 9 = upright, 1 = flat
** Necking score – based on percentage plot necked, where 1 = 10, 9 = 90%

Height

Early sown beans were considerably taller than late sown (Figure 2a). Nura was consistently the shortest, with 974* the tallest sown early and the same as 1269* sown late.

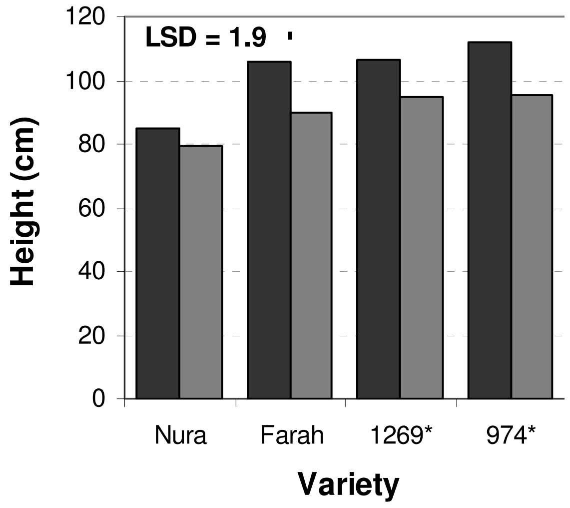


Figure 2a: effect of sowing time and variety on height of beans, Tarlee 2008.

Key Findings and Comments

- Early growth was rapid with the mild late autumn/early winter temperatures, but was then checked by the colder, frosty conditions of July and August. Near average rains through winter helped set the potential for good yields. Warm to hot days and much drier conditions in spring meant the beans were moisture stressed by early October, with flowering cut short and pod fill restricted.

- The absence of significant levels of disease infection, combined with tall bulky crops meant that variety performance was largely dictated by plant height/canopy density (early sowing) and flowering time (late sowing). The variety with the shortest plant height, Nura, was favoured at the early sowing and the earlier flowering variety Farah at the late sowing. Nura with its superior disease resistance and smaller plant type remains the best option for early (or dry) sowing of faba beans in favourable growing environments of SA. Manipulation of row spacing and or plant densities may be beneficial in taller bulkier varieties if they are to be sown at early dates.

- Lodging and necking were only at low levels in this trial in 2008 however severe necking (where the top part of the stem collapses and bends over sharply, but does not break completely) occurred in commercial bean crops again in 2008. Much of this was caused by the combination of high temperatures and high wind speeds over several days in mid-September, putting plants under severe moisture stress. Six National Variety Trial (NVT) bean trials were scored for necking damage, and although there was some variation between damage to individual varieties at different sites, Farah, Fiesta, Nura and Fiord showed similar average damage levels. No evidence was found that the level of necking damage to lines within a trial had any link to final grain yield – damaged plants still managed to fill the pods already set.

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 (Horsham), 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 and CICA0603 where used.

Table 1.1. Disease and agronomic characteristics of chickpea genotypes (varieties and advanced breeding lines) used in 2008 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
CICA0503	18 (17-19)		Average	Mid	Early/Mid	S	R	vase shape
CICA0613	20 (?)		Average	Late	Late	S	MR*	very high pods
CICA0603	20 (19-21)		Good	Early	Early	S	R*	
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	MR	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

R = resistant, MR = moderately resistant, MS = moderately susceptible, S = susceptible;

- Sowing Dates (28-29 May, 26 June-2 July)
- 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 (31.3)	Genesis 509 (15.9)	Genesis 079 (25)	Almaz (39.5)
15	49	24	39	62
30	99	49	79	124
45	148	73	118	187

- 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: Early sowing and wider row spacing's in standing stubble (60 and 30 cm c.f. 19cm) produced highest grain yields for chickpeas in 2008.
- Climate - The season in terms of rainfall was characterised by a break in mid May after a very dry autumn. Rainfall was well below average for the growing season and annually (Table 1.3). It was particularly notable that rainfall for September and October was significantly below the long term averages. Maximum temperatures were generally above average during September and October, with several days above 30°C in the later part of October (Fig 1.1). Minimum temperatures were below average from July to October, after being warmer than average in June (Fig 1.1). There were a few significant frosts recorded at Horsham during the flowering and podding periods of the lentils and chickpeas (the latest being October 9, -1.0 °C). During mid-late September there was a period of cooler weather and one frost (24 Sept) which caused flowering and pod set to be aborted in most chickpea genotypes.

Table 1.3. Monthly rainfall, growing season rainfall (GSR) and total rainfall (mm) at Horsham and Curyo in 2008 compared with long term averages.

	Horsham		**Curyo**	
Month	**2008**	**Average (Horsham)**	**2008**	**Average (Birchip)**
Januray	44.2	23.3	na	20.5
February	1.4	24.7	0	24.7
March	7.4	23.3	1.2	23.1
April	9.4	31.5	5.6	25.2
May	37.8	46.5	5	38.5
June	33.8	49.6	21.6	38
July	50.8	46.8	24.8	38.1
August	36.4	48.5	39.4	38.5
September	21.4	46	11.4	39.2
October	5.6	43.8	6.6	38.2
November	11.6	33.5	39.2	26.5
December	68.2	27.7	36	23.6
GSR (May-Oct)	185.8	281.2	108.8	228
Total	328	445.2	266.2	375.6

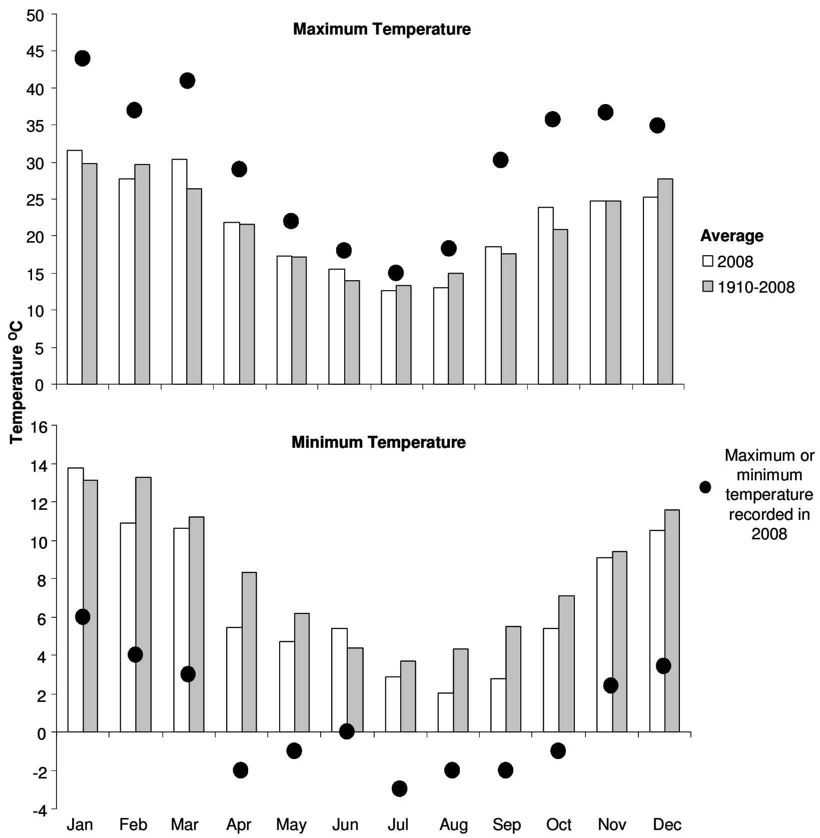


Figure 1.1. Average monthly maximum and minimum temperatures at Horsham in 2008 in comparison with long term data (approximately 100 years) and highest and lowest recorded temperature for the month.

- 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, plant density was reduced. There were no differences in plant establishment between sowing dates.
- Flowering time – There were no major impacts of row spacing or plant density on flowering time in chickpeas in 2008 (data not shown). It was extremely difficult to accurately assess relative flowering times of the different genotypes sown in May as during mid-late September there was a period of cooler weather and one frost (24 Sept) which caused flowering and pod set to be aborted in all genotypes except Sonali, which has improved cold tolerance. Generally, Sonali, Genesis 079 and 99226*02HS001 where earlier flowering than other genotypes. The relative difference between flowering times of genotypes was very little this season compared with other seasons, because of the dry spring conditions. There was less than 10 days between early and late flowering genotypes at both sowing dates.

Table 1.4. Relationship between target plant density (plants/m^2) and actual plant establishment in chickpeas for each row space at Horsham in 2008

Target	sl, 0.19	sl, 0.3	ST, 0.3	ST, 0.6
15	19	16	15	12
30	27	25	26	20
45	38	35	33	25
lsd(P<0.05)$_{PD}$ = 3				

- 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. There were no effects of plant density on crop and pod height. However both crop and pod height was reduced by delayed sowing (Fig 1.2). In addition, crop and pod height was increased by approximately 10% in the 60cm row spacing treatment compared with all other row space treatments, which were similar. The tallest genotype was 01040-1057 and shortest 99226*02HS001, however crop and pod height were not always directly correlated for all genotypes. For example, the pod height in Almaz was 80% of the crop height, while in Genesis 079 and 99226*02HS001 pod height was < 55% of the crop height. Further investigation is needed in seasons with higher yield potential to fully understand the interactions observed here and implications for variety development.

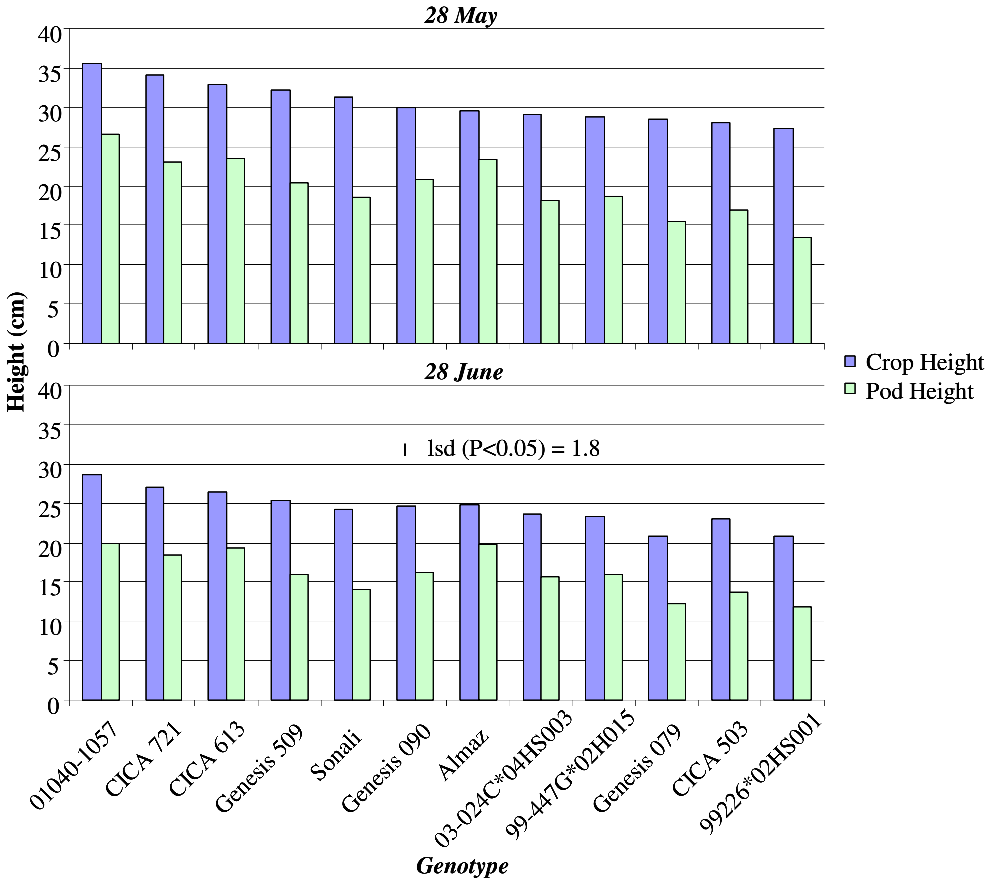


Figure 1.2. The effect of the interaction between sowing date and chickpea genotype on crop height and pod height at Horsham in 2008.

- Grain Yield – Grain yields in 2008 were extremely low and ranged between 0 and 0.4t/ha, with a site mean of 0.2 t/ha, hence results need to be interpreted with extreme caution (Tables 1.5 and 1.6). There was no interaction between sowing date, row spacing, plant density and genotype. Generally, grain yields were reduced at the later sowing date (June 28). Sonali had the highest yield when sown May 28, and Genesis 079 when sown June 28 (Table 1.5). Almaz was lowest yielding for both sowing dates. The higher yield of Sonali sown May 28 demonstrates the benefits of cold tolerance, as in most seasons this genotype has grain yields 10%-20% less than standard genotypes, such as Genesis 090. When comparing across row spacing's, the grain yield in the 60cm row spacing was almost double that of the 19cm row spacing (Table 1.6). In addition, there was a significant difference between the standing and slashed stubble treatments sown at 30cm row spacing, with the standing treatment producing higher yields. There was little effect of plant density on grain yield (not shown). Similar to previous seasons there was a trend towards a positive response to increased plant density in Genesis 509 at the latest sowing date.

Table 1.5. The effect of the interaction between sowing date and chickpea genotype on grain yield (t/ha) at Horsham in 2008.

Sowing Date	01040-1057	03-024C*04HS003	99-447G*02H015	99226*02HS001	Almaz	CICA 0503	CICA 0613	CICA 0721	Genesis 079	Genesis 090	Genesis 509	Sonali
28 May	0.17	0.20	0.19	0.24	0.10	0.22	0.25	0.21	0.19	0.23	0.25	0.27
28 June	0.15	0.15	0.16	0.17	0.08	0.20	0.19	0.18	0.24	0.20	0.20	0.17

lsd(P<0.05)$_{SDxgenotype}$ = 0.08, comparison of SD within genotype = 0.05

Table 1.6. The effect of row spacing on the grain yield (t/ha) of chickpeas sown at Horsham in 2008.

Row space	Grain Yield
sl, 0.195	0.13
sl, 0.3	0.16
ST, 0.3	0.22
ST, 0.6	0.25

lsd(P<0.05)$_{RS}$ = 0.06

- Seed Size – Due to the low grain yields no major effects of row spacing and plant density on seed size were noted. However there appeared to be a slight trend toward smaller seed size in treatments sown May 28 compared with the June 28.

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

Please see notes for trial 1 above.

Treatments

- Genotypes (as per trial 1 above)
- Sowing Dates (21-22 May, 23-24 June)
- Plant Densities (as per trial 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: Early sowing and wider row spacing's in standing stubble (60 and 30 cm c.f. 19cm) produced highest pod heights and grain yields for chickpeas in 2008. Herbicide damage symptoms were more severe in narrow row spacing's (19cm).

- Plant establishment – Similar to Horsham, trends for plant establishment were common across all genotypes, in that, at wider row spacing's plant density was reduced. Generally achieved plant densities were below target plant densities at higher sowing rates (Table 1.7). Almaz had slightly lower plant establishment than other genotypes. There were no differences in plant establishment between sowing dates.
- Herbicide Damage – Crop damage was observed and recorded from application of pre-sowing and post sowing pre-emergent herbicides (simazine + balance @ 800 + 100g/ha) at Curyo. When applied pre-sowing in the no-till wider row plots (30cm and 60cm row space), very little or no crop damage was observed, however on the conventionally sown 19 cm row space plots, significant damage was observed (Table 1.8). There were no major differences observed between genotypes.
- Flowering time – There were no major impacts of row spacing or plant density on flowering time in chickpeas in 2008. Sonali and 99226*02HS001 where flowered earliest when sown May 21, however Genesis 079 was earliest when sown June 23 (Table 1.9). Almaz and 01040-1057 were the latest flowering genotypes at both sowing dates.

Table 1.7. Relationship between target plant density and actual plant establishment in chickpeas for each row space at Curyo in 2008.

Target	sl, 0.19	ST, 0.3	ST, 0.6
15	17	14	12
30	29	23	21
45	36	33	28
lsd(P<0.05)	3		

Table 1.8. Main effect of row space treatment across all chickpea genotypes at each sowing date on the symptoms of herbicide damage (1 – no symptoms, 9 – complete death) observed row space at Curyo in 2008.

Row Space	21 May	23 June
sl, 0.19	3.7	3.7
ST, 0.3	1.5	1.0
ST, 0.6	1.3	1.0
lsd(P<0.05)rs = 1.2		

Table 1.9. Flowering time of chickpea genotypes at each sowing date at Curyo in 2008.

Sowing Date	Genesis 079	Genesis 090	Genesis 509	Almaz	01040-1057	03-024C*04HS003	99-447G*02H015	99226*02HS001	CICA 0503	CICA 0613	CICA 0721	Sonali
21 May	120 *17 Sep*	122 *19 Sep*	119 *17 Sep*	125 *23 Sep*	125 *22 Sep*	121 *19 Sep*	122 *19 Sep*	113 *11 Sep*	119 *17 Sep*	124 *22 Sep*	121 *18 Sep*	113 *11 Sep*
23 June	101 *02 Oct*	109 *10 Oct*	110 *10 Oct*	112 *12 Oct*	112 *13 Oct*	111 *11 Oct*	107 *07 Oct*	105 *05 Oct*	103 *03 Oct*	113 *13 Oct*	108 *09 Oct*	103 *03 Oct*

- Crop and Pod Height – Crop and pod heights at Curyo were significantly greater than Horsham, although trends across treatments were similar. There were no effects of plant density on crop and pod height. However, both crop and pod height were reduced by approximately 25% when sowing was delayed (Fig 1.3). In addition, pod height increased between 5% (Almaz) and 40% (Genesis 079) in the 60cm no-till, row spacing treatment compared with the 19cm row spacing treatment (Table 1.10). The tallest genotype was 01040-1057 and shortest 99226*02HS001, however the ranking of genotypes from tallest to shortest was slightly different at Curyo than Horsham (eg. Genesis 079 ranked lower and Almaz higher at Curyo compared with Horsham. Similar to Horsham crop and pod height were not always directly correlated for all genotypes (Fig 1.3). The pod height of Almaz was approximately 80% of the crop height, whilst for Genesis079 this was less than 50%.

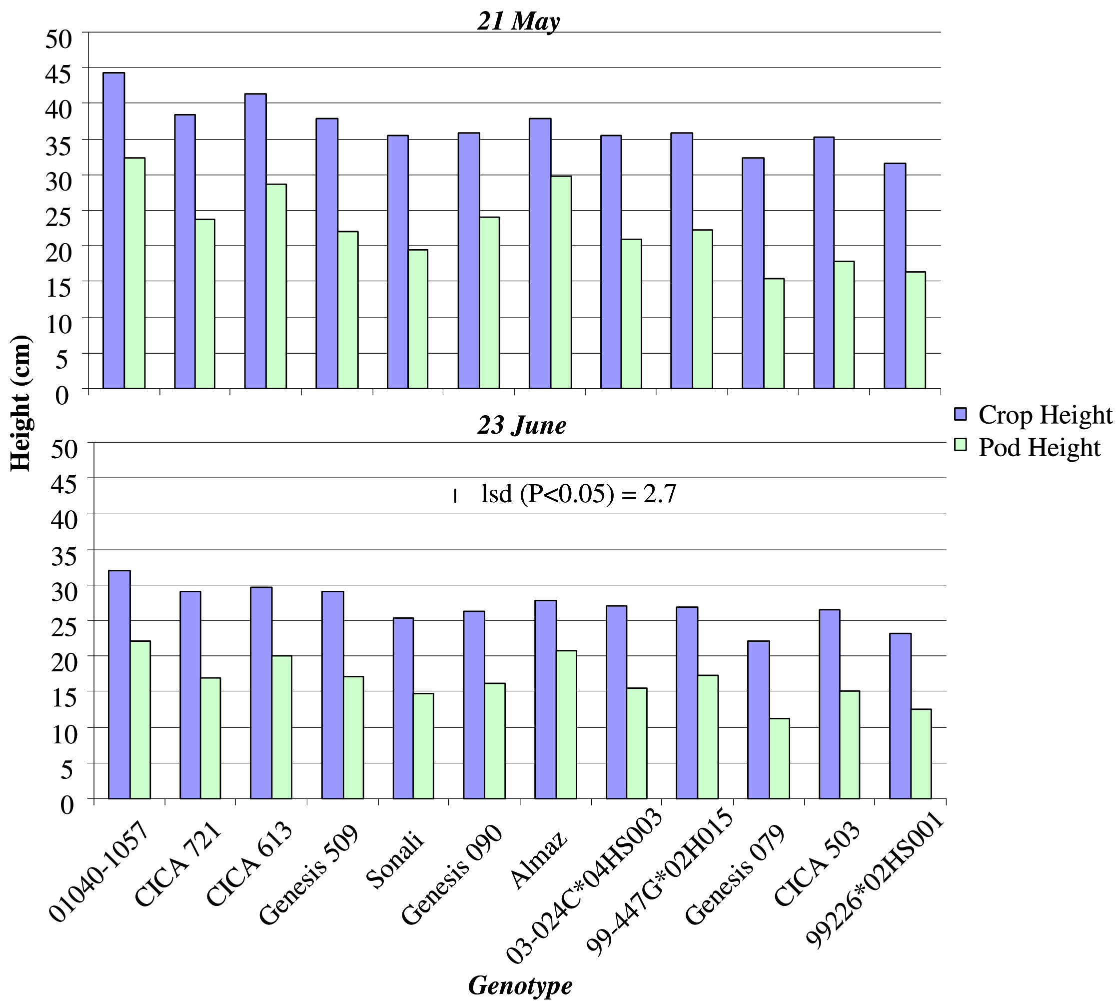


Figure 1.3. The effect of the interaction between sowing date and chickpea genotype on crop height and pod height at Curyo in 2008. (Note: height ranking from left to right based on Horsham heights).

Table 1.10. The effect of the interaction between row spacing and chickpea genotype on pod height at Curyo in 2008.

Row Space	Genesis 079	Genesis 090	Genesis 509	Almaz	01040-1057	03-024C*04HS003	99-447G*02H015	99226*02HS001	CICA 0503	CICA 0613	CICA 0721	Sonali
sl, 0.19	9.7	17.2	16.4	25.5	26.3	15.7	18.0	12.9	15.8	23.8	20.0	16.2
ST, 0.3	15.3	21.0	21.0	24.2	27.5	18.8	20.2	14.5	15.3	25.7	19.3	17.0
ST, 0.6	15.0	22.0	21.2	26.2	27.7	20.0	21.0	15.8	18.2	23.7	21.7	18.3

lsd $(P<0.1)_{RSxgen} = 3$

- Grain Yield – Grain yields in 2008 were low, but significantly higher than Horsham ranging between 0.1 and 0.6 t/ha, with a site mean of 0.34 t/ha, hence results need to be interpreted with caution (Tables 1.11, 1.12 and 1.13). There was no 4-way interaction between sowing date, row spacing, plant density and genotype. However, there were 2-way interactions between sowing time and genotype, row spacing and genotype, and plant density and genotype. Grain yields were generally reduced at the later sowing date, however the relative reduction in yield across genotypes, differed significantly (Table 1.11). 99226*02HS001 had the highest yield when sown early, but had a 45% yield reduction with delayed sowing. CICA0503 was the highest yielding genotype when sown late, but still had a 30% yield reduction from the early sowing treatment. Almaz was lowest yielding for both sowing dates, similar to that observed at Horsham. Grain yields were also reduced in the narrow row spacing (sl, 0.19) treatment compared with wider rows (ST, 0.3 and ST, 0.6; Table 1.12). Yield reductions of between 35% (eg. CICA0721 and 01040-1057) and 65% (eg. Genesis 509 and Genesis 079) were observed. It is likely that a proportion of the observed yield reduction is attributable to the increased herbicide damage observed in the narrow row spacing treatment. However, further work is required to fully understand differences in response observed among genotypes. Increased plant density resulted in higher yields at Curyo in 2008 for all genotypes compared, except Almaz (Table 1.13). The trend was consistent across all row spacing's and sowing dates.

Table 1.11. The effect of the interaction between sowing time and chickpea genotype on grain yield (t/ha) at Curyo in 2008.

Sowing Date	Genesis 079	Genesis 090	Genesis 509	Almaz	01040-1057	03-024C*04HS003	99-447G*02H015	99226*02HS001	CICA 0503	CICA 0613	CICA 0721	Sonali
21 May	0.42	0.50	0.45	0.29	0.36	0.31	0.39	0.56	0.53	0.38	0.38	0.38
23 June	0.22	0.28	0.26	0.16	0.26	0.26	0.31	0.31	0.37	0.32	0.29	0.21

lsd$(P<0.05)_{SDxgen} = 0.12$

Table 1.12. The effect of the interaction between row spacing and chickpea genotype on the grain yield (t/ha) at Curyo in 2008.

Row Space	Genesis 079	Genesis 090	Genesis 509	Almaz	01040-1057	03-024C*04HS003	99-447G*02H015	99226*02HS001	CICA 0503	CICA 0613	CICA 0721	Sonali
sl, 0.19	0.14	0.29	0.17	0.17	0.23	0.15	0.22	0.31	0.36	0.29	0.24	0.19
ST, 0.3	0.41	0.43	0.48	0.26	0.35	0.35	0.42	0.49	0.53	0.39	0.38	0.37
ST, 0.6	0.40	0.45	0.42	0.24	0.35	0.35	0.39	0.50	0.47	0.36	0.38	0.34

lsd$(P<0.05)_{rsxgen} = 0.10$

Table 1.13. The effect of the interaction between plant density and chickpea genotype on the grain yield (t/ha) at Curyo in 2008.

Plant Density (Plants/m^2)	Genesis 079	Genesis 090	Genesis 509	Almaz
15	0.29	0.34	0.27	0.20
30	0.32	0.39	0.36	0.22
45	0.42	0.41	0.39	0.21
lsd$(P<0.05)_{PDxgen}$ = 0.06				

- Seed Size and Grain Weight – No major effects of row spacing and plant density on seed size were noted. However there appeared to be a slight trend toward smaller seed size produced sown May 21 compared with the June 23 (Table 1.14). Grain weights were generally higher when sown June 23 compared with May 21 for all genotypes, except Almaz.

Table 1.14 The effect of the interaction sowing date and genotype on the seed size index of chickpea genotypes sown at Curyo in 2008.

Sowing Date	Genesis 079	Genesis 090	Almaz
21 May	6.56	7.05	8.25
23 June	6.55	7.13	8.07
lsd$(P<0.05)_{SDxgen}$ = 0.23, comparison of sowing date within genotype = 0.10			

- OTHER NOTES – Branching patterns were recorded on the maturity biomass cuts. These indicated that there was more secondary branching in the 23 June sown plots than 21 May sown plots. In addition there appeared to be less secondary branching at the wider row spacing treatments. Total biomass was between 1.5-2.5 t/ha for 21 May sown plots and 1-1.5 t/ha for 23 June sown plots, indicating that the potential yield was much higher than observed, if significant rain had fallen during spring. Data indicated here is available in summary tables available upon request.

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

Treatments

- Genotypes - All genotypes in Table 2.1 were used.

Table 2.1 Disease and agronomic characteristics of lentil genotypes and advanced breeding genotypes used in 2008 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
CIPAL411	Mod	MR	MR	MR	Mid	Early/Mid	erect/high pods/crop topping
CIPAL415	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	
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
99-088L*02H051	Mod	R		MS	Mid/Early	Mid	

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

- Sowing Dates (28-29 May, 26 June-2 July)
- 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** (5.2)	**Nipper** (3.1)	**CIPAL415** (3.6)
70	27	38	23	26
110	43	60	36	42
150	58	82	49	57

- 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: The yield in wider rows (30cm) with standing stubble was generally greater than in the narrow rows (19cm) and wide rows with slashed stubble. Crop and pod height was increased by approximately 10% -30% in the 30cm row spacing treatments compared with the narrow 19cm treatment.

- Climate – See Chickpeas above (Table 1.3 and Fig. 1.1)
- Plant establishment – Establishment for most lentil genotypes was greater when sown June 28 compared with May 28 (Table 2.3). However, establishment was 10% -30% less than targeted (Table 2.4).
- Flowering time – No meaningful data was achieved in 2008 due to dry and cold conditions.

Table 2.3. Establishment (plants/m^2) of lentil genotypes sown May 28 and June 28 at Horsham in 2008.

Sowing Date	99-088L*02H051	Aldinga	Boomer	CIPAL 411	CIPAL 415	CIPAL 501	CIPAL 605	CIPAL 607
28 May	78	83	83	81	85	85	81	80
28 June	88	89	82	107	87	98	87	93
	CIPAL 610	**CIPAL 611**	**CIPAL 801**	**CIPAL 802**	**CIPAL 803**	**Nipper**	**Northfield**	**Nugget**
28 May	76	82	81	90	78	84	82	74
28 June	93	89	101	94	90	89	81	92
lsd(P<0.05)$_{SDxgen}$ = 10								

Table 2.4. Relationship between target plant density and actual plant establishment (plants/m^2) in lentils for each row space at Horsham in 2008

Sowing Date	Target Plant Density	Boomer	CIPAL 415	Nipper	Nugget
28 May	**70**	62	57	62	61
	110	83	85	84	74
	150	105	101	100	102
28 June	**70**	63	63	66	56
	110	83	87	89	92
	150	113	109	123	121
lsd(P<0.05)$_{PDxgen}$ = 12					

- Crop and Pod Height – There were no effects of plant density on crop and pod height. However both crop and pod height was reduced by 10% to 40% when sowing was delayed (Tables 2.5 and 2.6). In addition, crop and pod height was increased by approximately 10% -30% in the 30cm row spacing treatments compared with the narrow 19cm treatment (Table 2.7). There was also a slight increase in crop and pod height in the standing stubble treatment compared with slashed stubble at the 30cm row spacing. There no major difference in response of varieties to row spacing. Genotypes such as CIPAL415, CIPAL610, Nipper and Northfield, produced pods at a significantly lower height than 99-088L, Boomer, CIPAL411, CIPAL611 and CIPAL801. Further investigation is needed in seasons with higher yield potential to fully understand the interactions.

Table 2.5. The effect of the interaction between sowing date and lentil genotype on crop height (cm) at Horsham in 2008.

Sowing Date	99-088L*02H051	Aldinga	Boomer	CIPAL 411	CIPAL 415	CIPAL 501	CIPAL 605	CIPAL 607
28 May	23.9	20.2	20.7	22.2	20.4	21.8	20.4	18.8
28 June	17.6	16.6	16.2	17.9	14.7	16.8	15.6	15.9
	CIPAL 610	**CIPAL 611**	**CIPAL 801**	**CIPAL 802**	**CIPAL 803**	**Nipper**	**Northfield**	**Nugget**
28 May	20.9	23.3	24.1	23.3	22.1	19.8	19.1	19.9
28 June	16.7	17.8	17.2	18.3	16.0	14.9	15.4	15.0
lsd(P<0.05)$_{SDxgen}$ = 1.7								

Table 2.6. The effect of the interaction between sowing date and lentil genotype on pod height (cm) at Horsham in 2008.

Sowing Date	99-088L*02H051	Aldinga	Boomer	CIPAL 411	CIPAL 415	CIPAL 501	CIPAL 605	CIPAL 607
28 May	14.0	12.0	14.3	13.3	11.1	13.7	11.4	11.0
28 June	9.8	9.8	9.8	11.7	6.7	9.2	8.4	8.1
	CIPAL 610	**CIPAL 611**	**CIPAL 801**	**CIPAL 802**	**CIPAL 803**	**Nipper**	**Northfield**	**Nugget**
28 May	11.0	15.0	14.2	13.4	12.6	10.9	11.4	12.1
28 June	9.2	11.1	9.3	9.8	8.6	7.9	8.8	7.3
lsd(P<0.05)$_{SDxgen}$ = 1.7								

Table 2.7. The effect of the interaction between sowing date and plant density on crop and pod height (cm) of lentils at Horsham in 2008.

Row Spacing	Crop Height		Pod height	
	28 May	28 June	28 May	28 June
sl, 0.19	19.9	15.2	10.8	7.3
Sl, 0.3	20.8	16.1	12.9	9.0
ST, 0.3	23.2	17.9	14.0	11.0
	lsd(P<0.05) = 0.7		lsd(P<0.05) = 0.7	

- Grain Yield – Grain yields in 2008 were extremely low and ranged between 0 and 0.4t/ha, with a site mean of 0.2 t/ha, hence results need to be interpreted with extreme caution (Fig 2.1). There was no major interactions between sowing date, row spacing, plant density and genotype. Generally, grain yields were reduced at the later sowing date (Fig 2.1). 99-088L produced the highest yields and Northfield lowest. The yield in wider rows (30cm) with standing stubble was generally greater than in the narrow rows (19cm) of wide rows with slashed stubble (Fig 2.1).
- Seed Size – Seed size was significantly lower when sown May 28 compared with June 28 (Table 2.8 and 2.9). Row spacing had minimal effect on seed size, although there was a slight trend toward higher seed size at wide rows when sown May 28 and in narrow rows when sown June 28.

Table 2.8. The effect of the interaction between sowing date and lentil genotype on seed size (g/100seed) at Horsham in 2008.

Sowing Date	99-088L*02H051	Aldinga	Boomer	CIPAL 411	CIPAL 415	CIPAL 501	CIPAL 605	CIPAL 607
28 May	4.1	4.0	5.1	3.6	3.0	3.9	3.9	2.9
28 June	4.7	4.8	6.1	4.5	3.7	4.7	4.8	3.3
	CIPAL 610	**CIPAL 611**	**CIPAL 801**	**CIPAL 802**	**CIPAL 803**	**Nipper**	**Northfield**	**Nugget**
28 May	3.9	3.6	3.4	3.3	3.3	2.7	2.5	3.2
28 June	4.4	4.6	4.0	3.9	4.0	3.2	3.2	3.9
lsd(P<0.05)$_{SDx\ gen}$ = 0.1								

Table 2.9. The effect of the interaction between sowing date and row space on seed size (g/100seed) at Horsham in 2008.

Row Spacing	28 May	28 June
sl, 0.19	3.5	4.3
sl, 0.3	3.5	4.2
ST, 0.3	3.6	4.2
	lsd(P<0.05)$_{SDxRS}$ = 0.1	

- Other Information - Biomass ranged between 1.5-2.5t/ha sown May 28 and 0.8-1.5t/ha sown June 28, giving an indication of the potential yield if weather conditions had been favourable (data not shown).

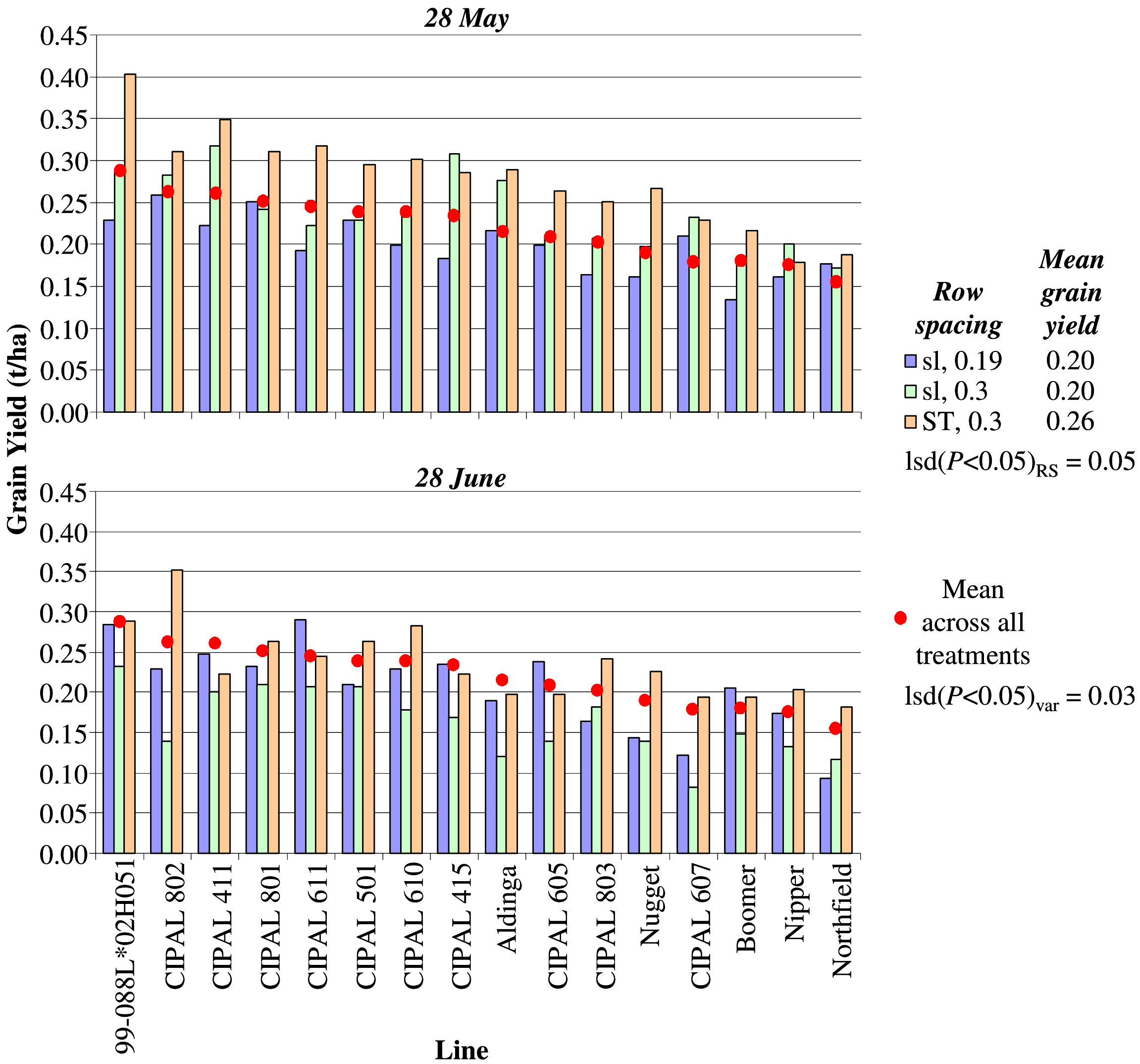


Figure 2.1. The effect of the interaction between sowing date, row space and lentil genotype on grain yield at Horsham in 2008.

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)
- Sowing Dates (28-29 May, 26 June-2 July)
- 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: No grain yield recorded in 2008 due to poor environmental conditions.

- Plant establishment – Similar to Horsham, plant establishment was generally greater in the later sown treatments and lower than the target (Table 2.10 and 2.11).
- Herbicide Damage – Crop damage was observed and recorded from application of pre-sowing and post sowing pre-emergent herbicides (simazine @ 1000g/ha) at Curyo (Table 2.12). When applied pre-sowing in the no-till wider row plots (30cm row space), significantly less crop damage was observed than on the conventionally sown 19 cm row space plots (Table 2.12). In addition damage appeared slightly worse in the later sown plots (June 23). Genotype differences were observed with CIPAL415 and Nipper being worst affected and Boomer and CIPAL611 least affected.
- Flowering time – There were no major impacts of row spacing or plant density on flowering time in lentils in 2008 (Table 2.13). CIPAL610 was the earliest flowering genotype at both sowing dates and Northfield latest. Similar to previous seasons Boomer was relatively earlier flowering sown early and mid flowering sown later.

Table 2.10. Establishment (plants/m^2) of lentils sown May 28 and June 28 at Curyo in 2008.

Sowing Date	Establishment (plants/m^2)
21 May	81
23 June	97
lsd(P<0.05)	4

Table 2.11. Relationship between target plant density and actual plant establishment (plants/m^2) in lentils for each row space at Curyo in 2008

Target Plant density(plants/m^2)	Actual Plant Density (plants/m^2)
70	60
110	85
150	110
lsd(P<0.05)	9

Table 2.12. The effect of sowing date, row spacing and lentil genotype on herbicide damage scores at Curyo in 2008.

Sowing Time	Row Space	99-088L*02H051	Aldinga	Boomer	CIPAL 411	CIPAL 415	CIPAL 501	CIPAL 605	CIPAL 607	
21 May	**sl, 0.19**	5.7	3.3	3.0	3.3	4.7	3.0	4.0	4.0	
	ST, 0.30	2.3	1.0	1.7	2.0	2.3	2.3	2.0	1.7	
23 June	**sl, 0.19**	6.7	7.0	5.0	7.7	7.7	7.7	6.3	7.7	
	ST, 0.30	2.7	4.0	2.7	3.3	4.3	2.7	2.7	3.0	
	average	*4.3*	*3.8*	*3.1*	*4.1*	*4.8*	*3.9*	*3.8*	*4.1*	
		CIPAL 610	**CIPAL 611**	**CIPAL 801**	**CIPAL 802**	**CIPAL 803**	**Nipper**	**Northfield**	**Nugget**	**average**
21 May	**sl, 0.19**	4.7	3.0	3.7	4.0	3.3	5.0	4.7	4.0	
	ST, 0.30	2.0	1.3	2.0	1.7	2.3	2.3	1.7	2.3	
23 June	**sl, 0.19**	5.7	7.7	7.0	7.0	7.7	7.3	7.7	6.3	*5.5*
	ST, 0.30	2.7	2.3	3.0	3.0	2.7	3.3	2.7	3.0	*2.5*
	average	*3.8*	*3.6*	*3.9*	*3.9*	*4.0*	*4.5*	*4.2*	*3.9*	
	lsd(P<0.05)$_{var}$ = 0.8								lsd(P<0.05)$_{RS}$ = 1.4	

Table 2.13 Flowering time of lentil genotypes at each sowing date at Curyo in 2008.

Sowing Date	99-088L*02H051	Aldinga	Boomer	CIPAL 411	CIPAL 415	CIPAL 501	CIPAL 605	CIPAL 607
21 May	118 *16 Sep*	120 *18 Sep*	112 *09 Sep*	119 *17 Sep*	119 *17 Sep*	120 *18 Sep*	119 *17 Sep*	110 *07 Sep*
23 June	96 *26 Sep*	101 *01 Oct*	97 *27 Sep*	95 *26 Sep*	99 *30 Sep*	98 *29 Sep*	98 *28 Sep*	100 *01 Oct*
	CIPAL 610	**CIPAL 611**	**CIPAL 801**	**CIPAL 802**	**CIPAL 803**	**Nipper**	**Northfield**	**Nugget**
21 May	110 *08 Sep*	120 *17 Sep*	116 *14 Sep*	113 *11 Sep*	120 *18 Sep*	123 *20 Sep*	121 *18 Sep*	120 *17 Sep*
23 June	94 *25 Sep*	97 *28 Sep*	96 *26 Sep*	96 *27 Sep*	99 *30 Sep*	99 *30 Sep*	101 *01 Oct*	98 *29 Sep*

- Grain Yield – Although the trial was not specifically harvested for grain yield in 2008, attempts were made to recover some of the seed. It was observed that generally more seed was collected from the no-till wide row plots that conventionally sown plot. Maximum yields reached approximately 0.2t/ha.

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, 2008

Site	Turretfield (High rainfall)	Hart (medium rainfall)
Pea rotation	> 4 years	3 years
Cultivars	Kaspa, Alma, OZP0602, WA2211	Kaspa, Alma, OZP0602, WA2211
Sowing dates	May 9, May 30, June 20	May 1, May 21, June 8
Fungicide treatments	Nil, Fortnightly Bravo, PPT, PPT plus Mancozeb, 1 Mancozeb, 2 Mancozeb	Nil, Fortnightly Bravo, PPT, PPT plus Mancozeb, 1 Mancozeb, 2 Mancozeb
Blackspot level	moderate	moderate
Site mean grain yield (t/ha)	1.99	1.24

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 WA2211 and OZP0602 into these experiments to evaluate the potential benefits of improved blackspot resistance in field peas.

Results and Interpretation

Disease ratings
Disease levels (blackspot) reached moderate levels in the Hart and Turretfield experiments during winter but failed to progress further during spring due to a lack of rainfall and dry conditions. As in 2007 delayed sowing reduced the amount of blackspot infection and this effect continued throughout the growing season.

Disease spread and intensity was found to start earlier in the old conventional leaf type variety Alma. This variety continued to have greater levels of disease than the other varieties at both infected sites during the season. Of the other three lines evaluated Kaspa generally had higher levels than WA2211 which in turn had higher levels than OZP0602 (Table 2). These results indicated that improved genotypes for blackspot resistance do exist and are being progressed through Pulse Breeding Australia.

Grain Yield
There was no significant benefit of early sowing across all varieties in 2008, unlike in 2007. This was most likely due to frequent but erratic high temperature and frost events in early spring. However, there was no yield penalty from earlier sowing in the Kaspa and OZP0602, Table 2.

Also reducing the benefit of early sowing in 2008 was the early favourable season growing conditions (not at Minnipa). The early sowing treatments incurred higher disease levels, increased vegetative production and plant lodging. The latter was particularly evident at the higher rainfall site of Turretfield and in the older conventional type variety Alma.

Table 2: Effect of sowing date and cultivar on blackspot severity and grain yield in SA, 2008.

		Foliar black spot % plot severity, ( )=sqrt %plot sev.					Grain yield (t/ha)				
Site	Sow date	Alma	Kaspa	WA 2211	OZP 0602	Mean	Alma	Kaspa	WA 2211	OZP 0602	Mean
T/field	May 9	8.7 (2.9)	4.9 (2.2)	5.4 (2.2)	3.8 (1.9)	5.7 (2.3)	1.57	2.25	1.8	2.25	1.96
	May 30	3.3 (1.7)	2.1 (1.3)	1.1 (1)	1 (0.8)	1.9 (1.2)	1.74	2.2	1.76	2.43	2.03
Rated	June 20	0.1 (0.1)	0 (0.1)	0 (0)	0 (0)	0 (0.1)	1.59	2.12	2.06	2.09	1.96
31/7	Mean	4 (1.6)	2.3 (1.2)	2.1 (1)	1.62 (1)		1.63	2.19	1.87	2.25	
		lsd (P<0.05) = - , (0.35)					lsd (P<0.05) = 0.28 (0.15 same sow date)				
Hart	May 1	6.8	5.8	5	3.2	5.2	1.21	1.38	1.11	1.51	1.3
	May 21	2.3	1.1	0.8	0.6	1.2	1.2	1.25	1.18	1.47	1.28
Rated	June 8	0.7	0.1	0.2	0.1	0.3	1.09	1.11	1.13	1.26	1.15
23/7	Mean	3.3	2.4	2	1.3		1.17	1.24	1.14	1.42	
		lsd (P<0.05) = 1.2					lsd (P<0.05) = 0.17 (0.1 same sow date)				

NS = not significant, ND = No disease present, - = not evaluated at this site

Grain yields of the late flowering variety Kaspa decreased as sowing date was delayed (Table 2). This result also occurred in the 2007 experiments and has prompted the wide spread earlier commercial sowings of this variety in recent years. Alma was the lowest yielding variety at both sites and showed a variable response to changes in sowing date making it difficult to optimise Alma's grain yield through manipulation of sowing date. The early flowering Kaspa type line, OZP0602, was the highest yielding variety at both sites (15% higher yielding than Kaspa at Hart and 3% at Turretfield). At both sites OZP0602 was higher yielding than Kaspa when sown at the mid sowing time but similar yielding to Kaspa at the early sowing time.

Grain weight:

There was no consistent sowing date trend at either Hart or Turretfield for grain weight.
There was also no consistent comparison between sites, with Alma having higher grain weights at Hart and WA2211 at Turretfield. There were no large differences in Kaspa or OZP0602 between sites.

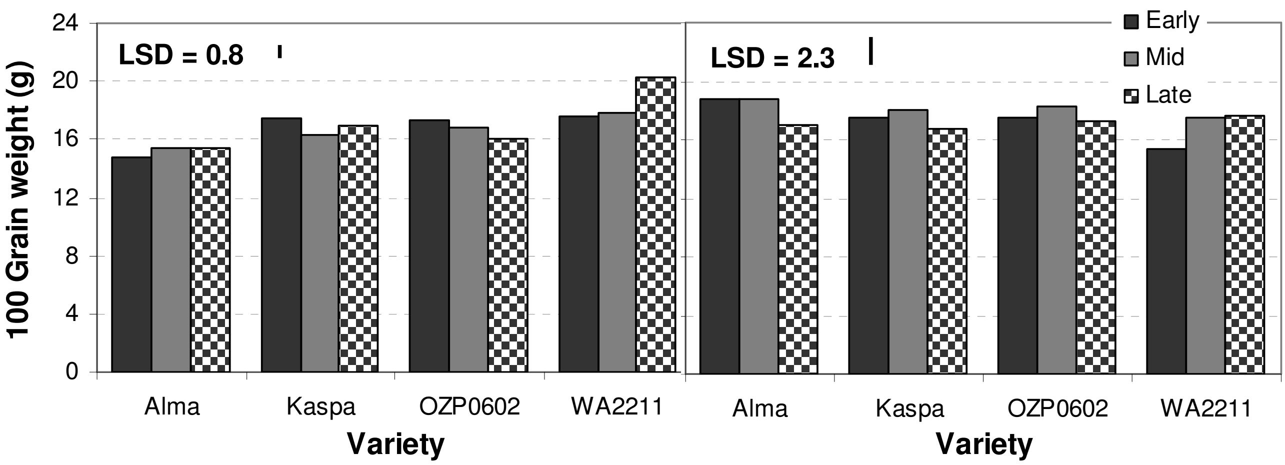


Figure 1a: Effect of sowing date and variety on grain weight at Turretfield, 2008.

Figure 1b: Effect of sowing date and cultivar on grain weight at Hart, 2008.

Key findings & comments

- Early sowing has maximised yields of field peas over the last three years at field sites in SA representing low, medium and high rainfall pea growing areas (Figure 2). Early sowing has been paramount for economical field pea production in low and medium rainfall areas over this period and continues to be the best management strategy providing consideration for black spot, weeds and frost risk occurs.

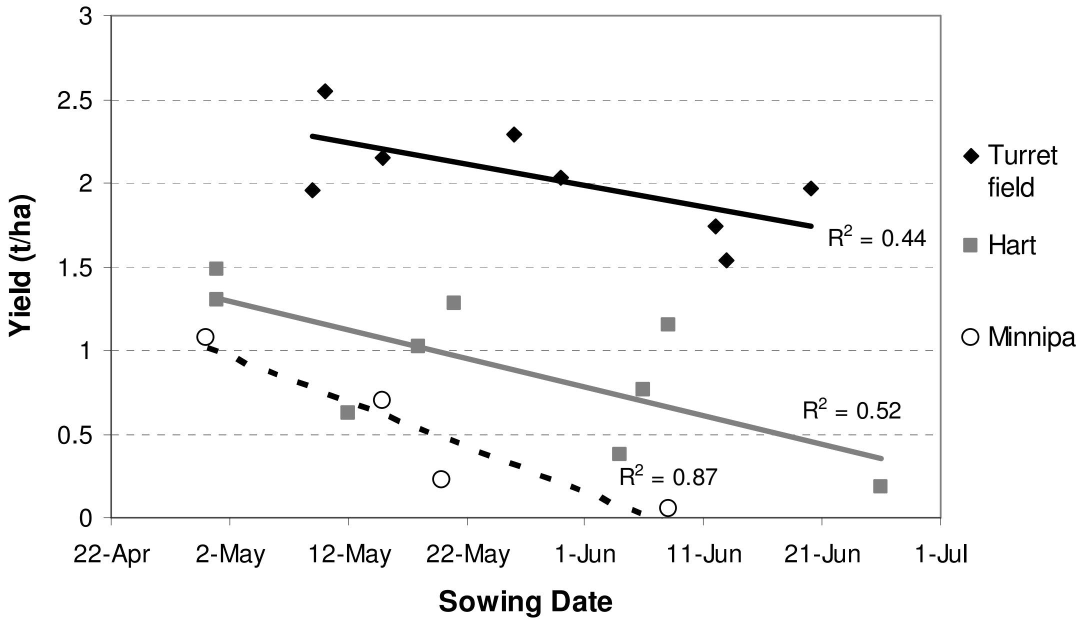


Figure 2: Effect of sowing date on grain yield of field peas at three sites in SA, 2006-2008.

- Providing management strategies like using rotational gaps of at least four years and not sowing pea crops next to neighbouring pea stubbles are implemented it is likely greater yield loss will occur from delayed sowing than from blackspot infection across seasons in low and medium rainfall environments.
- Kaspa & OZP0602 had lower disease severity and slower build up of blackspot than the old Alma cultivar and are therefore better suited to earlier sowing than this variety. OZP0602 had the lowest disease severity.
- Sowing field peas on the season break will increase blackspot risk however exposure to risk can be reduced through the use of the blackspot predictive tools (Blackspot Manager and DIRI) and careful paddock selection.
- The importance of an additive effect of varietal improvement, seed dressing and foliar sprays in allowing earlier sowing is not fully understood and requires further evaluation in a year more favourable for disease infection and spread.
- OZP0602 shows high yields, wide adaptation and suitability to SA conditions, particularly to low and medium rainfall areas where it may not need to be sown as early as Kaspa to maximise yields, providing a safer option where sowing needs to be delayed due to disease, frost, weed or excessive growth issues.

Acknowledgments

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

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 and other problem weeds 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.

Treatments:
Nil no desiccant applied.
Early Crop-top - Paraquat 250 (800ml /ha) 7-14 days pre ryegrass milky dough stage
Mid Crop-top - Paraquat 250 (800ml /ha) at ryegrass milky dough stage (latest timing for effective control)
Late Crop-top - Paraquat 250 (800ml /ha) 7-14 days post ryegrass milky dough stage

Sowing dates: Peas: Balaklava 29/5/09, Turretfield 4/6/09; Lentils: 28/5/09; Chickpeas: 27/5/09; Beans: 22/5/09

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

Varieties: Refer to Table 1 below.

Table 1. Flowering and maturity characteristics of pulse varieties evaluated in crop topping genotype by management trials, SA 2008.

Beans	Flow.	Mat.	Chickpeas	Flow.	Mat.	Peas	Flow.	Mat.	Lentils	Flow.	Mat.
Doza	E	E	**Almaz**	M-L	M-L	**Alma**	L	L	**Aldinga**	M	M
Fiord	E-M	E	**Genesis079**	E	E	**Bundi**	E	E	**Boomer**	E-M	M-L
Fiesta	E-M	E-M	**Genesis090**	M	M	**Dundale**	E	M	**Cumra**	E-M	E
Farah	E-M	E-M	**Genesis114**	M-L	M-L	**Glenroy**	L	L	**Digger**	M	M-L
Manafest	L	M	**Genesis509**	E-M	E-M	**Kaspa**	L	M	**Nipper**	M-L	M
Nura	M-L	E-M	**Howzat**	M	M	**Parafield**	M-L	M	**Northfield**	M-L	M
AF02002	M-L	M-L	**Sonali**	E	E	**Snowpeak**	E	E	**Nugget**	M	M-L
AFO2042	M	E-M	**CICA0503**	M	M	**SWCeline**	E	VE	**CIPAL411**	M	E-M
AF03001	E	E	**CICA0505**	M	M	**Sturt**	M	M-L	**CIPAL415**	M-L	M
AFO3021		M	**CICA0512**	M	M	**Yarrum**	L	M	**CIPAL501**	M	M-L
AFO3063	E	E-M	**CICA0603**	E-M	E-M	**OZP0601**	E	E	**CIPAL502**	M	M-L
AFO3092	L	E-M	**CICA0604**	M	M	**OZP0602**	E-M	E	**CIPAL605**	M	M
AFO4053	M-L	E-M	**CICA0713**	M	M	**OZP0701**	M-L	M-L	**CIPAL607**	M-L	M-L
AFO4064	E	E-M	**CICA0717**	M	M	**OZP0703**	M	E	**CIPAL610**	E-M	E
AFO4085	E-M	M	**CICA0718**	E-M	E-M	**OZP0705**	E	E	**CIPAL611**	M-L	M
IX101/1-55	E	E	**CICA0719**	E-M	E-M	**PSL4-RESEL**	VE	VE	**CIPAL701**	M	M-L
974*(611*974)/15	M-L	M-L	**01-481*03HS010**	VE	E	**94-425*2b**	VL	VL			
1269*483/6	E-M	L	**01-482*03HS009**	VE	E						
1270x278/10	E	E-M	**02-150C*04HS003**	E-M							
1487/7	E-M	E	**03-028C*04HS004**	E-M							

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

Results

Lentil

Grain yield and grain weight of lentil varieties were affected by the crop topping applications. The early treatment was 23% lower yielding than the nil treatment and incurred a 13% reduction in grain weight across all varieties (Table 2 & 3). The early flowering varieties Boomer and Cumra and CIPAL701 were the only lentils to not incur a yield loss compared with the nil treatment at the early crop topping timing and Boomer was the only variety which did not suffer a reduction in grain weight at this timing. Highest grain yield losses in this timing occurred in Nipper, Northfield, Nugget, CIPAL 411, CIPAL501, CIPAL607 and CIPAL611. At the mid application timing Northfield, CIPAL411, CIPAL501 and CIPAL611 still incurred a grain yield loss with Northfield and CIPAL501 also incurring a loss at the late application timing.

Table 2. Effect of Crop topping timing on grain yield (t/ha) of lentil varieties, Melton, SA, 2008.

Variety/ line	Nil t/ha	Early	Mid % nil	Late	Mean
Aldinga	1.769	81	101	108	1.725
Boomer	1.792	84	94	93	1.665
Cumra	1.323	97	105	111	1.367
Digger	1.588	80	85	100	1.45
Nipper	1.788	65	88	98	1.573
Northfield	1.863	69	82	72	1.508
Nugget	1.881	63	95	94	1.659
CIPAL411	2.153	70	84	88	1.839
CIPAL415	1.81	82	108	105	1.788
CIPAL501	1.859	68	76	78	1.494
CIPAL502	1.692	80	108	110	1.684
CIPAL605	1.779	82	102	106	1.735
CIPAL607	1.948	70	93	90	1.717
CIPAL610	2.194	79	90	93	1.988
CIPAL611	1.913	71	84	94	1.668
CIPAL701	1.927	87	99	99	1.854
Mean	1.83	1.40	1.70	1.75	
LSD (0.05)			0.23		0.1182

Table 3. Effect of Crop topping timing on grain weight (g/100 seeds of lentil varieties), Melton, SA, 2008.

Variety/ line	Nil g/100	Early	Mid % nil	Late	Mean g/100
Aldinga	4.38	87	101	105	4.31
Boomer	5.61	98	102	104	5.66
Cumra	3.64	92	103	104	3.63
Digger	3.54	87	98	102	3.42
Nipper	2.81	84	98	102	2.69
Northfield	2.89	83	94	90	2.65
Nugget	3.60	83	97	101	3.42
CIPAL411	4.30	87	99	99	4.14
CIPAL415	3.07	83	102	99	2.94
CIPAL501	4.72	82	99	97	4.46
CIPAL502	2.41	88	101	104	2.38
CIPAL605	4.40	83	102	103	4.28
CIPAL607	3.16	80	98	97	2.96
CIPAL610	4.52	93	100	104	4.49
CIPAL611	4.10	84	95	97	3.85
CIPAL701	3.35	92	105	103	3.35
Mean	3.78	3.29	3.77	3.81	
LSD (0.05)			0.12		0.1182

Field pea

As in the lentil trial, a significant interaction occurred between crop topping treatment and variety in both field pea experiments. At Balaklava a 33% grain yield and a 30% grain weight reduction occurred across all varieties from the early crop topping treatment when compared with the nil treatment. At the later maturing Turretfield site a 58% grain yield and 40% grain weight reduction occurred from the same treatment.

At Balaklava PSL4-RESEL and the low yielding variety, Yarrum, were the only lines not to incur a yield loss from the early treatment when compared with the nil. However all varieties suffered a reduction in grain weight. The varieties incurring the highest yield loss at this timing were Glenroy, Parafield, Sturt and OZP0701. At the mid timing only Parafield and OZO701 incurred a yield loss and only OZP0701 at the late timing. Response to grain weight reductions were varied at these two timings at Balaklava and didn't correlate to grain yield loss.

All varieties incurred a yield and grain weight reduction in the early crop topping treatment when compared with the nil treatment at Turretfield. The greatest yield loss occurred in the forage pea line (94-425*2b), however all varieties were heavily reduced in grain yield. At the mid treatment only the forage line incurred a yield and grain weight reduction compared to the nil treatment and no reductions occurred at the late timing.

Table 4. Effect of Crop topping timing on grain yield (t/ha) of field pea varieties, Balaklava, SA, 2008.

Variety/ line	Nil t/ha	Early	Mid % nil	Late	Mean
Alma	0.58	73	104	123	0.58
Bundi	0.88	65	94	96	0.78
Dundale	0.70	73	103	95	0.65
Glenroy	0.64	53	88	94	0.53
Kaspa	0.67	61	81	100	0.57
Parafield	0.90	49	74	85	0.69
Snowpeak	0.81	75	91	90	0.72
Sturt	0.97	56	86	98	0.83
SWCeline	0.82	71	91	106	0.75
Yarrum	0.43	81	112	129	0.46
OZP0601	0.85	79	98	96	0.79
OZP0602	0.85	66	90	98	0.76
OZP0701	0.93	54	82	80	0.73
OZP0703	0.80	76	106	102	0.77
OZP0705	0.91	72	86	93	0.80
PSL4-RESEL	0.75	87	103	103	0.74
Mean	0.78	0.53	0.72	0.76	
LSD (0.05)			0.12		0.05

Table 5. Effect of Crop topping timing on grain weight (g/100 seeds) of field pea varieties, Balaklava, SA, 2008.

Variety/ line	Nil t/ha	Early	Mid % nil	Late	Mean
Alma	13.92	69	90	106	12.70
Bundi	14.23	71	95	96	12.87
Dundale	14.21	81	104	102	13.76
Glenroy	14.81	57	81	92	12.22
Kaspa	13.95	64	79	91	11.65
Parafield	15.59	67	91	102	14.06
Snowpeak	15.76	76	93	98	14.44
Sturt	13.84	59	85	95	11.73
SWCeline	15.07	73	95	99	13.81
Yarrum	13.07	67	88	102	11.67
OZP0601	13.44	77	93	94	12.27
OZP0602	13.85	69	96	103	12.75
OZP0701	13.01	72	95	97	11.85
OZP0703	14.07	71	98	103	13.06
OZP0705	14.34	77	93	97	13.13
PSL4-RESEL	16.06	76	91	87	14.21
Mean	14.33	10.09	13.13	14.00	
LSD (0.05)			0.64		0.54

Table 6. Effect of Crop topping timing on grain yield (t/ha) of field pea varieties, Turretfield, SA, 2008.

Variety/ line	Nil t/ha	Early	Mid % nil	Late	Mean
Alma	1.15	50	119	127	1.14
Bundi	1.79	39	108	103	1.56
Dundale	1.62	47	92	87	1.32
Kaspa	1.89	31	105	107	1.62
Parafield	1.62	41	99	107	1.41
Snowpeak	1.84	46	98	102	1.59
Sturt	1.60	33	105	122	1.43
SWCeline	2.00	48	115	110	1.87
Yarrum	2.03	45	106	104	1.81
OZP0601	2.08	43	104	107	1.84
OZP0602	1.86	39	116	116	1.72
OZP0701	2.00	51	105	103	1.80
OZP0703	1.98	42	104	99	1.71
OZP0705	1.99	45	105	118	1.83
PSL4-RESEL	1.91	59	112	113	1.83
94-425*2b	1.01	9	63	95	0.67
Mean	1.77	0.76	1.85	1.90	
LSD (0.05)			0.26		0.12

Table 7. Effect of Crop topping timing on grain weight (g/100 seeds) of field pea varieties, Turretfield, SA, 2008.

Variety/ line	Nil t/ha	Early	Mid % nil	Late	Mean
Alma	14.58	63	94	110	13.39
Bundi	15.19	59	101	107	13.99
Dundale	16.37	61	91	94	14.18
Kaspa	15.89	49	99	102	13.95
Parafield	16.19	69	95	108	15.06
Snowpeak	15.31	66	97	102	13.93
Sturt	15.03	54	95	106	13.29
SWCeline	17.05	61	105	94	15.31
Yarrum	15.68	58	104	103	14.31
OZP0601	16.00	58	99	99	14.22
OZP0602	16.88	65	105	104	15.81
OZP0701	14.24	55	101	105	12.86
OZP0703	17.25	56	99	99	15.27
OZP0705	15.71	58	100	105	14.23
PSL4-RESEL	15.92	65	102	104	14.76
94-425*2b	12.38	65	75	104	10.64
Mean	15.61	9.39	15.30	16.01	
LSD (0.05)			1.14		0.56

Chickpea

The interaction between crop-topping treatment and variety was not significant for grain yield however it was for grain weight. The early and mid crop topping treatments were lower yielding and had lower grain weights than the nil treatment, however the late treatment incurred no reduction in either measurement. All varieties incurred yield losses and grain weight reductions in the early crop topping treatment when compared with the nil treatment. Genesis090 incurred grain yield losses in both the early and mid treatments, as did Howzat, CICA0503 and CIC0604. No variety was lower yielding than its respective nil treatment at the late timing, although Geneiss 090 incurred a grain weight reduction.

Table 8. Effect of Crop topping timing on grain yield (t/ha) of chickpea varieties, Melton, SA, 2008.

Variety/ line	Nil t/ha	Early	Mid % nil	Late	Mean
Almaz	0.83	65	90	97	0.73
Genesis079	1.41	81	96	109	1.36
Genesis090	1.18	61	83	98	1.00
Genesis114	0.96	57	94	97	0.84
Genesis509	1.36	73	98	100	1.27
Howzat	1.45	71	86	98	1.28
Sonali	1.48	75	94	101	1.37
CICA0503	1.51	64	87	99	1.32
CICA0505	1.49	70	91	100	1.34
CICA0512	1.28	67	93	101	1.15
CICA0603	1.68	68	87	90	1.45
CICA0604	1.57	69	85	98	1.38
CICA0713	1.45	74	91	105	1.35
CICA0717	1.46	79	95	102	1.37
CICA0718	1.51	71	89	96	1.35
CICA0719	1.44	70	96	103	1.33
01-481*03HS010	1.50	82	100	108	1.46
01-482*03HS009	1.36	85	94	105	1.31
02-150C*04HS003	1.44	75	103	105	1.38
03-028C*04HS004	1.31	75	89	96	1.18
Mean	1.38	1.00	1.27	1.39	
LSD (0.05)			0.11		0.0771

Table 9. Effect of Crop topping timing on grain weight (g/100 seeds) of chickpea varieties, Melton, SA, 2008.

Variety/ line	Nil t/ha	Early	Mid % nil	Late	Mean
Almaz	41.83	73	100	98	38.74
Genesis079	21.00	80	99	100	19.89
Genesis090	31.20	91	92	94	29.38
Genesis114	38.23	83	95	97	35.79
Genesis509	13.38	85	101	104	13.06
Howzat	18.28	76	94	99	16.88
Sonali	16.84	82	97	102	16.02
CICA0503	17.73	80	96	101	16.73
CICA0505	18.32	77	102	103	17.49
CICA0512	18.51	88	100	105	18.15
CICA0603	20.96	78	99	99	19.67
CICA0604	17.84	75	102	101	16.83
CICA0713	20.86	77	93	94	19.02
CICA0717	23.06	80	97	101	21.76
CICA0718	22.60	75	97	95	20.76
CICA0719	17.16	79	104	101	16.46
01-481*03HS010	24.73	80	103	101	23.71
01-482*03HS009	17.93	86	98	100	17.22
02-150C*04HS003	15.19	83	98	103	14.55
03-028C*04HS004	19.65	82	96	96	18.39
Mean	21.77	17.48	21.30	21.56	
LSD (0.05)			0.45		0.67

Faba bean

A preliminary analysis of the faba bean data from Cockaleechie found no significant response in grain yield to the crop topping treatments despite considerable differences in yield measured between treatments and varieites. A treatment effect did occur for grain weight, where the early and mid crop topping treatment produced lower grain weights than the late and nil treatments, however the variety by treatment interaction was not significant. A large spatial trend across the experiment was observed for plant growth and grain yield due most likely due to an interaction between soil type and the dry spring conditions. A further more sophisticated spatial analysis to allow for these trends will be conducted to determine if there were significant differences between varieties and treatments in faba beans.

Key findings & comments

- Dry and hot spring conditions reduced grain yields and led to early senescence of pulse varieties in 2008 particularly in late flowering and/or maturing types. Many of the grain yield reductions expected at the mid and late crop topping timings were 'masked' due to premature senescence in many varieties brought on by these dry spring conditions.
- The early crop topping treatment reduced grain yields of field peas, lentils and chickpeas compared with the nil treatment, however there were field pea and lentil lines identified which did not incur a yield loss at this timing, indicating suitability to this agronomic practice.
- Some lines in all crops were found to incur yield loss and grain weight reductions at the appropriate timing for crop topping indicating poor suitability to this agronomic practice.

- Not all early flowering and maturing lines were able to be safely crop topped in the 2008 experiments nor did all late lines always incur a yield loss. Further evaluation is required to confirm findings in a year where varieties are not prematurely senesced by drought conditions.
- Detailed grain quality measurements (seed size distribution, colour, hydration percentage) are currently occurring on some treatments and varieties to assess the effects of crop topping and desiccation on seed quality.

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

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)

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 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	CICA503	semi-spread	moderate	medium-thin	medium	mid
	Genesis 509	semi-erect	moderate	thin	medium	mid
	Sonali	semi-erect	good	medium	tall	early
	01482*03HS002	erect	very good	very thin	very tall	mid
	01152-1029	semi-erect	moderate	dense	medium	mid
	01040-1057	erect	good	very dense	tall	mid
	01040-1160-1	semi-erect	moderate	very dense	medium	mid

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

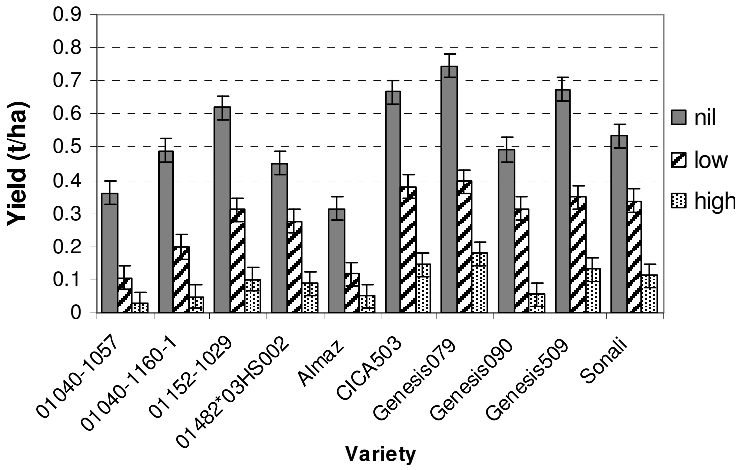
[b] Canopy density refers to the density of the mature canopy, and is important in preventing light penetration

Grain yield

Due to the dry season, and particularly the severe finish to 2008, chickpea yields were very low, averaging just 0.54t/ha without competition. Competition with ryegrass reduced grain yields by 48% in the low treatment and by 82% in the high treatment (Table 2).

All lines decreased in yield as ryegrass density increased, with the exception of Almaz, which yielded similarly (and poorly) at both low and high ryegrass densities (Figure 1). The early flowering Genesis 079 generally yielded consistently higher in each ryegrass treatment. This is a reflection of both the early maturity and its suitability to short season environments.

Breeder's lines 01040-1057 and 01040-1160-1, and commercial variety Genesis 090 showed the lowest yield loss at the low rate of competition (Figure 2). At the high rate of competition breeder's lines 01040-1057 and 01040-1160-1 were once again the least affected, together with Almaz. This may indicate these varieties are more competitive with ryegrass, however as the dry season suppressed plant growth and expression of variation in growth habit, further research is required in a more favourable season to compare these genetic differences.



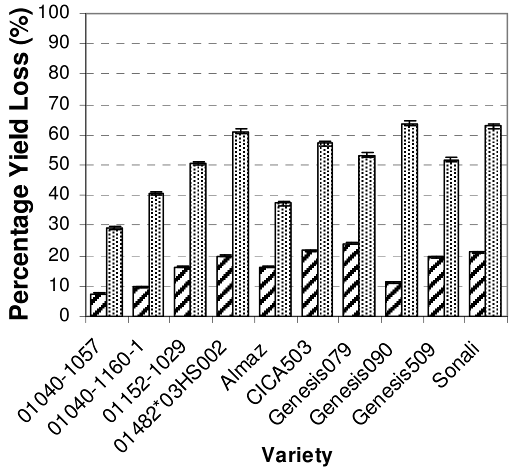


Figure 1: Effect of ryegrass density on the yield of 10 chickpea lines, Hart 2008
Figure 2: Percentage yield loss of chickpeas under low and high ryegrass densities, Hart 2008

Table 2: Effect of ryegrass density on various chickpea and ryegrass measurements at Hart, 2008

Measurement		Ryegrass Density			LSD(0.05)
		Nil	Low	High	
Ryegrass Counts	Plants/m^2	0	33.4	120.5	7.9
	Tillers/m^2	0	138.1	309.5	25.1
	# tillers/plant	0	4.1	3	-
Chickpea Counts (#/m2)	July	48.1	48.2	51.5	ns
	October	49.7	46.7	43.3	3.02
Yield (t/ha)		0.54	0.28	0.095	0.023

Grain weight

Grain weights were consistently reduced by increasing competition with ryegrass (Table 3). Almaz had the heaviest seeds, while Genesis 509 and Sonali had the lightest.

Sonali was the least affected variety at the low ryegrass density, with grain weight 95% of the nil, however this was reduced to 78% at the high density. Genesis090 was least affected variety at the high ryegrass density, with 89% of the nil grain weight, and moderately affected at the low density (93%). Grain weight of Genesis079 was affected to the greatest extent at both low and high ryegrass densities, reaching just 80% and 72% of the nil weights, respectively.

Table 3: Effect of ryegrass density on grain weight of 10 chickpea varieties, Hart 2008

Variety	Ryegrass Density		
	Nil	Low	High
01040-1057	20.5	18.2	16.9
01040-1160-1	20.7	18.8	17.7
01152-1029	24.0	21.6	19.7
01482*03HS002	21.6	20.2	18.7
Almaz	40.0	34.0	31.3
CICA503	19.0	17.5	15.8
Genesis 079	22.1	17.6	16.0
Genesis 090	27.4	25.5	24.6
Genesis 509	16.6	15.4	13.7
Sonali	17.8	16.9	13.8

LSD (0.05) = 1.3

Ryegrass counts and tillering

The ability of chickpea lines to suppress tillering in ryegrass was deemed to be one of the most important measurements at the beginning of the trial. However tiller numbers were heavily reduced by the dry season, making comparisons between varieties difficult.

Initial plant counts (July) were less than target densities, with the low density (target = 40 plants/m^2) measuring 33 plants/m^2, and the high density (200 plants/m^2) measuring just 120 plants/m^2 (Table 2). Comparisons between these two treatments showed that ryegrass tillering was reduced by 27% by the four-fold increase in rye grass plant density.

Almaz showed better tiller suppression than the four breeder's lines, but not more than the other commercial varieties (Figure 3). Findings in 2007 at Turretfield where higher ryegrass tillering and increased chickpea dry matter production occurred showed that Sonali had better tiller suppression than all other varieties tested. Further validation is required of this work.

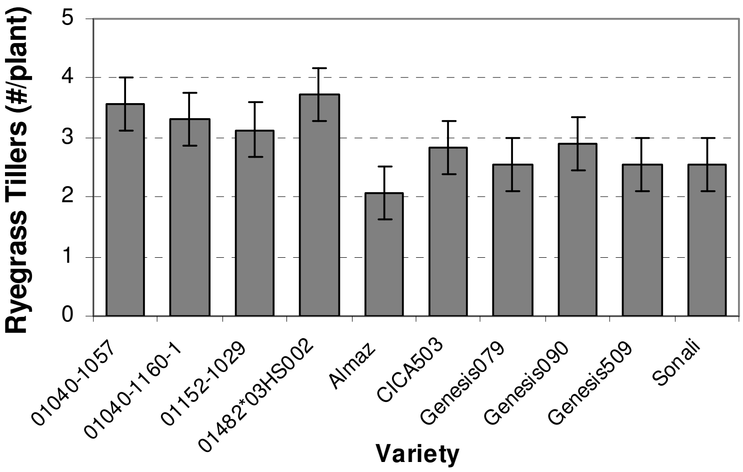


Figure 3: Ryegrass tillering capacity under competition with 10 chickpeas lines, Hart 2008.

Chickpea Density

Initial counts (July) showed no difference in chickpea density between treatments or varieties. There was also no difference in chickpea density between nil and low ryegrass treatments, however thinning of chickpeas was observed at the higher ryegrass density (Table 2), reflecting plant death due to greater competition for soil moisture.

The plant density of breeder's line 01482*03HS002 was the lowest at the October count, indicating that a greater plant mortality had occurred in this variety. This line was the only chickpea with a combination of erect growth habit and thin canopy, suggesting that this plant type may be less competitive with ryegrass.

Key findings & comments

- Dry seasonal conditions did not favour chickpea production in 2008 and consequently early maturity and low grain yields were observed.
- Ryegrass competition of 33 plants/m^2 at maturity reduced grain yields of chickpeas by 48%, and 120 plants/m^2 reduced grain yields by 82%.
- Genesis 079 was the highest yielding variety and is well adapted to short season environments.
- Further work in more favourable seasons is required to compare genotypic differences of chickpeas to define a more competitive plant type.
- These results confirm previous findings showing chickpeas as a poor competitor, and the unsuitability of control measures such as weed-wiping and crop-topping due to yield losses from weed competition prior to application.

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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.

4. Weed Competition in chickpeas: (Larn McMurray)

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