

Variety specific management for pulses – sowing date and plant density

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The aim of this trial was to determine optimum sowing time and plant density for new cultivars of field pea, lentil and chickpea

Summary

Trials were sown at Birchip and Kalkee to investigate the effects of sowing time and plant density on new cultivars of field pea, lentil and chickpea. Results indicate that management practices will need to be slightly modified in many instances to maximise the yield benefits of these new cultivars. For example, the new pea variety Kasper should generally be sown slightly earlier and at higher density than the traditional cultivars Parafield and Dundale.

Background

New pulse cultivars have significant agronomic and yield improvements compared with older cultivars. However, pulses are sensitive to agronomic management and will respond to appropriate management techniques. Previous research has indicated that pulse cultivars can vary widely in their response to sowing date and plant density. This research focuses on the development of management packages for the new cultivars to optimise yield and quality. Field trials conducted during 2003 compared the effect of sowing time and plant density on the performance of four recently released or potential cultivars of peas, one of lentil and two chickpeas with commonly grown cultivars. The new cultivars display improvements including disease resistance, plant architecture (standability), seed quality and yield, whilst there are also changes in flowering and maturity that could affect agronomic management.

Methods

Trials were sown at Birchip (BCG main site) and Kalkee (TLC field day site) to compare varieties of field pea, lentil and chickpea. The experiment was designed as a split plot with 3 replicates (i.e. the plant densities and cultivars were randomized within each replicate of the sowing date).

Note: In the field pea trials, due to a shortage of seed of Sturt, 2 breeding lines were substituted for some of the treatments at the 2 later sowing dates (see below).

Treatments and design

Sowing dates:

Birchip: May 7, June 4 & July 7

Kalkee: May 22, June 11 & July 14

Plant densities:

Field peas: 15, 35, 55, 75 & 110 plants/m²

Note: At mid and late sowing dates Sturt was only sown at 35 plants/m² and 89-036*9-10 and 96-286*1 sown at 35 and 55 plants/m².

Lentils: 60, 90, 120, 150, 250 plants/m²

Chickpeas: 15, 30, 45, 60 & 90 plants/m²

Sowing rates (kg/ha) were calculated based on the seed weight of each cultivar, e.g. Sturt and Parafield sown at 35 plants/m² had sowing rates of 75 and 85 kg/ha, respectively.

Cultivars

Field peas

Table 1a. Cultivar descriptions of field peas sown at Birchip and Kalkee in sowing time and plant density trials in 2003

Cultivar	Leaf type	Plant height	Grain type	Flowering time	Pod shatter resist ⁿ	Lodging resist ⁿ	Black Spot	Downey mildew	Powdery mildew
Kaspa	SL	Tall dwarf	Dun	Late	R	MS/MR	MS/S	R	S
Parafield	Conv	Tall trailing	Dun	Mid	MS	S	S	S	S
Snowpeak	SL	Tall dwarf	White	Early	MS/S	MR	S	R	S
Sturt	Conv	Tall trailing	White	Mid	MS	S	S	MS	S
89-036*9-10	SL	Med dwarf	White	Early	R	MS/MR	S	R	S
96-286*1	SL	Tall dwarf	Dun	Mid	S	MS/MR	MS/S	R	S

SL = semi-leafless, Conv = conventional; T = tall, M = medium; S = susceptible, MS = moderately susceptible, MR = moderately resistant, R = resistant

Table 1b. Descriptions of lentil cultivars sown at Birchip and Kalkee in sowing time and plant density trials in 2003

Cultivar	Grain type	Maturity	Lodging resistance	Botrytis grey mould	Ascochyta blight Foliage	Ascochyta blight Seed
Nugget	Red	Medium	MR	MR/MS	MR	MS
CIPAL102	Red	Medium	MR	R	R	R

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

Table 1c. Descriptions of chickpea cultivars sown at Birchip and Kalkee in sowing time and plant density trials in 2003.

Cultivar	Grain type	Seed size	Ascochyta blight Foliage	Ascochyta blight Seed	Height	Flowering Time	Maturity
Howzat	Desi	Med-Large	MS	MS	Medium	Early	Mid
ICCV96836	Desi	Med	MR	MS	Tall	Mid	Mid/Late
Flip 94-508c	Desi	Small	R	MS	Medium	Mid/Late	Mid/Late

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

Paddock management

Grain legume mix with 2% zinc at 60 kg/ha at Birchip and 80 kg/ha at Kalkee was applied with seed at sowing. Weeds were controlled using a pre-sowing knockdown followed by post sowing pre-emergent and post emergent sprays. Fungicides were applied to lentil and chickpea trials to prevent fungal diseases. Insect pests were controlled using insecticides as required.

Measurements

A range of weather, soil and plant measurements were recorded, however this report focuses mainly on grain yield. Details regarding other measurements can be provided upon request.

The lentil and chickpea trials have been analysed using ANOVA, but due to the unbalanced design of the field pea trials no analyses have been completed prior to the time of writing.

Results

Weather

Birchip

Above average rainfall was recorded during winter after a below average start in May (Table 2). Spring was generally warm with below average rainfall resulting in terminal drought. Frost was recorded (-1°C) on the 28th and 30th September, but this had little effect on pod growth and development.

Kalkee

Winter rainfall was average to above average after a below average start in May (Table 2). Spring was generally warm and relatively dry, which resulted in terminal drought, particularly in chickpeas. In particular there were some long dry periods in October and November

Table 2. Rainfall (mm) recorded at Birchip and Kalkee in 2003 in comparison with long-term averages.

	May	June	July	Aug	Sept	Oct	Nov	Dec	GSR ¹
<i>Birchip</i>									
2003	18.4	48.6	33.0	65.2	20.2	39.0	8.0	0.0	224.4
Average Birchip PO	38.5	38.0	38.1	38.5	39.2	38.2	26.7	23.7	230.5
<i>Kalkee</i>									
2003	28.6	70.0	30.6	79.0	34.2	59.4	12.2	N/A	301.8
Average Longrenong	44.0	44.7	43.3	41.0	43.4	30.6	27.3	N/A	247.0

1. GSR - Growing season rainfall (Birchip: May to October; Kalkee: May to November)

Plant growth and grain yield

Lentils

Birchip

Number of seed emerged was similar for both cultivars (data not shown). At the first two sowing dates, target plant densities were achieved, while at the last sowing date, number of seed emerged was 10-20% less than the target density. Waterlogging and root rot, primarily in early sown plots, were major limitations to growth in several plots in this trial.

Sowing date significantly affected grain yield but plant density had little effect. Highest yields were achieved in plots sown June 4 (Table 3). Nugget yielded 32%, 25% and 15% more than CIPAL 102, respectively, at each of the sowing dates.

Table 3. Average grain yield (t/ha) of the lentil cultivars Nugget and CIPAL 102 across all plant densities within a sowing date at Birchip.

Sowing date	Nugget	CIPAL102
May 7	1.29	0.89
June 4	2.17	1.64
July 7	0.66	0.54

LSD ($P<0.05$) 0.32

Kalkee

Number of seed emerged was similar for both cultivars (data not shown). At the first two sowing dates, target plant densities were achieved, while at the last sowing date, number of seed emerged was 10-20% less than the target density. Plant growth was generally adequate throughout the season with no sign of disease.

There was a significant interaction between sowing date and cultivar on grain yield. Nugget had 50%, 30% and 10% higher yields, respectively, at each of the sowing dates than CIPAL 102 (Table 4a). The highest yields for Nugget were in plots sown May 22 and for CIPAL 102 in plots sown June 11. Both varieties responded similarly to increasing plant densities at all sowing dates, i.e. highest yields were achieved at higher plant densities (Table 4b).

Table 4a. Average grain yield (t/ha) of the lentil cultivars Nugget and CIPAL 102 across all plant densities within a sowing date at Kalkee.

Sowing date	Nugget	CIPAL102
May 22	2.99	1.56
June 11	2.62	1.89
July 14	1.73	1.57

LSD ($P<0.05$) 0.21

Table 4b. Average grain yield (t/ha) of lentils across all sowing dates for each plant density.

	Plants/m ²				
	60	90	120	150	250
Grain Yield (t/ha)	1.68	1.90	2.17	2.13	2.40

LSD ($P<0.05$) 0.19**Field Peas****Birchip**

Number of seed emerged was similar for all varieties at all sowing dates. The lowest three target plant densities were achieved, but at higher densities seed emergence was 10 and 15% less than planned (data not shown).

Plant growth was excellent throughout the year. However, powdery mildew appeared late in the season, particularly affecting late sown plots. The exception was 89-036*9-10 which showed almost no symptoms.

Grain yields were generally excellent for plots sown May 7 or June 4, and often exceeded 2.5 t/ha. Plots sown July 7 yielded approximately half that of earlier sown plots (Table 5). Kasper sown May 7 at 35-75 plants/m² had the highest grain yield. The highest yield for Parafield was achieved at 35 plants/m² sown June 2; Snowpeak at 55 plants/m² sown May 7; Sturt at 35 plants/m² sown May 7. Both new cultivars showed increased yield at the higher plant density used in this trial. The grain yields of 89-036*9-10 sown at 55 plants/m² were the highest of any sown rate and cultivar sown June 4 or July 7 (Table 5).

Table 5. Grain yield (t/ha) of the field pea cultivars sown at Birchip in 2003.

Sowing rate (plants/m ²)	Kasper	Parafield	Snowpeak	Sturt	89-036*9-10	96-286*1
Sown: May 7						
15	2.83	2.54	1.99	2.53		
35	3.35	2.93	2.69	3.18		
55	3.39	2.60	2.86	2.81		
75	3.29	2.30	2.72	2.80		
110	2.98	2.31	2.66	2.80		
Sown: June 4						
15	2.34	2.22	1.53			
35	2.94	3.02	2.11	2.96	2.83	2.05
55	2.94	2.90	2.19		3.23	2.56
75	2.99	2.80	2.29			
110	2.63	2.63	2.68			
Sown: July 7						
15	0.76	1.04	0.76			
35	1.24	1.18	1.36	1.65	1.61	1.20
55	1.39	1.46	1.40		1.77	1.52
75	1.48	1.46	1.56			
110	1.49	1.60	1.74			

Kalkee

Number of seed emerged was similar for all varieties at all sowing dates. The lowest three plant densities were achieved, while at the highest two plant densities number of seeds emerged was 10-15% less than the target density (data not shown).

Disease was a major limitation to plant growth at this site, particularly at earlier sowing dates. Most plots of all cultivars sown May 22 and June 11 were severely affected by black spot and bacterial blight, but were able to recover and produce grain. Some plants were killed whilst the growth of others was severely retarded. This often delayed flowering i.e. the flowering time of plots sown May 22 or June 11 was later than plots sown July 14. Cultivars differed in their response to bacterial blight. Generally, Parafield, Sturt and 96-286*1 showed least symptoms whilst Snowpeak and 89-036*9-10 displayed the worst symptoms.

Despite the presence of disease symptoms, adequate grain yields were achieved for all varieties except Snowpeak, which appeared unable to recover from the disease outbreak. The highest yields were achieved by Parafield (3.45 t/ha) sown June 11 at a plant density of 55-75 plants/m² and 96-286*1 sown June 11 at 35-55 plants/m² (3.4-3.6 t/ha; Table 6). (Note: the actual number of plants surviving at harvest was likely to be less than that observed at emergence due to plant death from disease). Snowpeak was generally the lowest yielding cultivar, but still produced grain yields greater than 2.2 t/ha when sown late (July 14) at high plant densities. All cultivars responded similarly to plant density, but differently to sowing date. The highest yields at all sowing dates were achieved at plant densities greater than 55 plants/m². Kasper yielded best in treatments sown May 22 or June 11, Parafield at June 11, Snowpeak at July 14, Sturt at June 11, 89-036*9-10 at July 14 and 96-286*1 at June 11 (Table 6).

Table 6. Grain yield (t/ha) of the field pea cultivars sown at Kalkee in 2003.

Sowing rate (plants/m²)	Kasper	Parafield	Snowpeak	Sturt	89-036*9-10	96-286*1
Sown: May 22						
15	1.97	1.09	0.69	1.05		
35	2.60	1.81	1.34	2.00		
55	2.67	2.09	1.41	2.54		
75	2.61	2.36	1.69	2.59		
110	2.71	2.52	1.48	2.71		
Sown: June 11						
15	1.98	2.90	1.27			
35	2.38	3.18	1.06	3.32	2.20	3.39
55	2.68	3.46	1.38		2.25	3.59
75	2.14	3.44	1.63			
110	2.59	3.18	1.72			
Sown: July 14						
15	1.24	1.96	1.26			
35	1.90	2.60	1.80	2.98	2.72	2.53
55	2.29	2.74	2.35		3.10	2.83
75	2.33	2.77	2.63			
110	2.93	2.94	2.45			

Chickpeas

Birchip

Number of seed emerged was similar for all varieties. At the first two sowing dates target densities were achieved. At the last sowing date target densities of the three lowest plant densities were achieved, while at the highest two plant densities number of seeds emerged was 10-15% less than the target density (data not shown).

Plant growth was good throughout the year; however some plots were affected by waterlogging. Late sown plots were generally stunted in growth, showing symptoms of drought.

Grain yields ranged from 0.36 to 1.46 t/ha. Howzat being the highest yielding cultivar at all sowing dates (Table 7a). The highest yields for all cultivars were in plots sown June 4. The yield of all cultivars increased with increasing plant density. (Table 7b).

Table 7a. Average grain yield (t/ha) of the chickpea cultivars Howzat, ICCV96836 and Flip 94-508c across all plant densities within a sowing date at Birchip.

Sowing date	Howzat	ICCV96836	Flip 94-508c
7 May	0.92	0.66	0.45
4 June	1.46	1.22	0.59
7 July	0.69	0.61	0.36

LSD ($P < 0.05$) **0.19**

Table 7b. Average grain yield (t/ha) of chickpeas across all sowing dates for each plant density.

Plants/m²					
15	30	45	60	90	

Grain Yield (t/ha)	0.54	0.72	0.77	0.88	0.93
LSD ($P < 0.05$)	0.14				

Kalkee

Not all plots were harvested at the time of writing.

Interpretation

Lentils

- Low yields at Birchip in early sown plots were due to effects of waterlogging and root rot.
- At both Kalkee and Birchip the results indicate that maximum yields resulted from sowing prior to mid June confirming findings of previous trials. Generally at Birchip the optimum date is mid/late May.
- The currently recommended plant density of 120 plants/m² was adequate (approximately 50 kg/ha for Nugget in 2003). It is unlikely that there would be any economic improvement in yield from increasing seeding rates.
- CIPAL 102 was less sensitive to sowing date than Nugget, i.e. the relative difference in yield between early and late sowing was less for CIPAL 102 than Nugget. This shows that it is more critical to sow Nugget earlier than a cultivar like CIPAL 102.

Field Peas

- Kaspas continues to be the highest yielding cultivar in the Mallee, particularly when sown earlier than current practise. Its major benefits are ease of harvest (lodging resistant) and pod shatter resistance. Its lower yield than Parafield in the Wimmera this year was probably related to a greater susceptibility bacterial blight.
- Both new breeding lines show promise and are likely to respond to higher plant densities than are currently used 55 c.f. 35 plants/m². In particular, at Birchip the line 89-036*9-10 was excellent (this line is a large white pea with pod shatter resistance; a sister line to Kaspas).
- Results at Kalkee showed that peas were able to recover from serious infections of bacterial blight and black spot to produce adequate grain yields.
- The results indicated that if you wish to sow late, optimum plant densities are greater than 55plants/m².

Chickpeas

- At Birchip, the grain yields for chickpeas this year were disappointing considering the amount of growth they put on during the season, particularly at the earliest sowing date. Low yields probably reflect the dry finish and a lack of stored moisture at the time of sowing.

Commercial Practice

Lentils

- Nugget continues to be the recommended cultivar until new disease resistant lines becomes available over then next few years. To maximise yield, currently recommended sowing dates (southern Mallee – late May/early June; Wimmera – mid June) and rates (120 plants/m²) should be followed.
- Before sowing ensure that you determine your seed size so you accurately calculate seeding rates for target density of 120 plants/m².

Field Peas

- The incorporation of pod shatter resistance and improved lodging resistance associated with the semi leafless character into new cultivars will result in significant improvements in yield. This could be even more so in farmers paddocks, due to the improved harvestability associated with these characters.
- In the Wimmera, peas did not produce grain yields that are competitive with lentils or chickpeas on a gross margin basis.

Chickpeas

- Several new chickpea cultivars will be released to growers in the coming years. It is recommended that people pay particular attention to the specific management package recommended for the cultivar they wish to grow. The new cultivars require less fungicide, but may need to be sown at different sowing dates and plants densities than previous cultivars.
- At Birchip, it is likely that new chickpea cultivars will need to be sown by the end of May/early June to maximise yields. Further work is required to ascertain optimum plant densities.
- Flip 94-508c is only likely to be useful in the Wimmera where disease pressure is higher and growers need to spray the crop more often. This cultivar is likely to reduce the number of fungicide sprays to 2 or 3.