Pulse Agronomy Trials Farmers Report 2000

Jason Brand (Pulse Agronomist)
Ph 5362 2341, Mob 0409 357 076
Agriculture Victoria - Horsham
(Victorian Institute for Dryland Agriculture)
Private Bag 260, Horsham Victoria 3401.

GRDC project title: Increasing profitability of pulses on alkaline soils by improved agronomic management (DAV 439).

TAKE HOME MESSAGE

- Sowing depth had no effect on emergence, biomass production or grain yield in lentils and field peas.
- Field peas - Early sowing (early - mid May) beneficial at the Mallee sites for newer varieties (PSL4, Snowpeak and Excell).
- Lentils - Later sowing (mid June - early July) beneficial this year due to late rainfall.

INTRODUCTION

The successful expansion of the pulse industry into the marginal areas of the southern Mallee and northern Wimmera is limited by various soil constraints (salinity, boron toxicity and sodicity) and variable and often low rainfall. To overcome these constraints we can breed (identify new varieties) for improved tolerance of the conditions and improve our agronomic management of the crop.

The principal aim of this project is to identify the key agronomic management requirements for increased productivity and profitability of pulses (field peas, chickpeas and lentils) under variable seasonal conditions on soils other than grey clays. Throughout the four years of the project the effects of sowing time, seeding rate and sowing depth on several lines of field peas, lentils and chickpeas will be determined at a number of sites in the southern mallee.

In 2000, experiments were conducted at three sites. These focused primarily on field peas and lentils, due to the lack of suitable ascochyta resistant varieties in chickpeas. The interaction between and individual effects of sowing time, sowing depth and variety were assessed.

TRIAL DESIGN

Sites

Three sites were used:
Rosebery - southern mallee (Duplex soil, sandy loam topsoil, clay subsoil)
Warne - southern/central Mallee (Duplex soil, clay loam topsoil, sodic clay subsoil)
Kaniva - western Wimmera (black cracking clay)
Collaborators are listed below in acknowledgments.
Climate data was recorded for all sites (rainfall - table 1; all other information including temperature, humidity and wind speed - please contact me)

Replicates

4

Varieties

The tables below provide some of the characteristics of the varieties included in trials. Only characteristics that were relevant to their inclusion in the trial are given.

Table 1. Key characteristics of lentil varieties included in 2000 field trials.

Variety	Characteristics
Nugget	Highest yielding, botrytis grey mould (MR), ascochyta blight 'foliar' (MR), ascochyta blight 'seed' (MS)
Digger[1]	Sister line of Nugget with similar traits, but slightly lower yield
Cassab	Earlier flowering than other lines, botrytis grey mould (MR), ascochyta blight 'foliar' (MR), ascochyta blight 'seed' (MS)
Northfield	Botrytis grey mould (S), ascochyta blight 'foliar' (MR), ascochyta blight 'seed' (R), salinity tolerance?

Table 2. Key characteristics of field pea varieties included in 2000 field trials.

Variety	Characteristics
Dundale[1]	Dun, early flowering
Snowpeak	White, semi-leafless, downey mildew (R), early flowering
Excell	Blue, semi-leafless, downey mildew (R), early flowering
PSL4	Dun, tall, late flowering, high yield, semi-leafless, ascochyta blight (MR), downey mildew (R), shatter resistant, harvestability

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

[1]In the lentil trials Digger was the control, whilst in the field pea trials Dundale was the control.
**NOTE: At Rosebery only 3 varieties were used (Northfield and PSL4 were removed from the lentil and field pea trials, respectively).

Treatments
There were 4 sowing dates (Table 3) and 2 depths of sowing (3 cm and 8cm) at sowing date 1 and sowing date 2. At sowing dates 3 and 4 seed was sown at 8 cm.

Table 3. Sowing dates at each of the trial site in 2000

Site	Sowing date 1	Sowing date 2	Sowing date 3	Sowing date 4
Rosebery	2 May	24 May	13 June	4 July
Warne	3 May	23 May	13 June	4 July
Kaniva	9 May	31 May	20 June	11 July

Note: A chickpea trial comparing three varieties across the treatments outlined below was also conducted at Rosebery. However, due to an early ascochyta outbreak in the sowing date 1 treatment and a lack of resources for adequate management, it was decided to abandon the trial in August. It was ploughed in by the farmer.

COLLABOATORS AND ACKNOWLEDGEMENTS
I wish to thank and acknowledge the farmers who provided land for these trials: Rosebery - Jeff Kranz, Warne - Ian McClelland, Kaniva - Bradley Champness.

I also wish to acknowledge the support of the agronomy technical staff who worked on this project during 2000.

PADDOCK HISTORY
Table 4. Cropping history of paddocks into which 2000 trials were sown.

Site	2000	1999	1998	1997
Rosebery	Field pea	Barley	Canola	Lentil
Warne	Lentil	Fallow	Wheat	Lentil
Kaniva	Field Pea	Barley	Chickpea	Wheat

CHEMICALS

Herbicides

Pre-sowing

Initial paddock preparation was left to the collaborating farmer.
At Warne the site was sprayed with Sprayseed (2L/ha) 1 day prior to sowing the first sowing date.
At Rosebery and Kaniva the site was sprayed with Roundup (2L/ha) 1 day prior to sowing the first sowing date.
At later sowing dates for all sites the plots to be sown were spot sprayed with round-up (2L/ha) to minimise damage from drift. However, at Warne some drift occurred onto sowing date 1, which did cause some yield loss.

Post sowing/pre-emergent

Lexone 100g/ha.
Roundup 2L/ha.
Only applied at the first sowing date - no sprays were used at later sowing to minimise damage from drift.

Post emergent

No herbicides were used in-crop to control broad-leaf weeds.
Verdict 300ml/ha was applied six weeks after sowing to control grass weeds.
All sites were hand weeded in late winter.

Insecticides

Endosulfan 1L/ha was applied post sowing/pre-emergent to control red-legged earth mite.
Scud EC 500ml/ha was applied 3 times from early pod fill to late pod fill to control Heliothus.

Fungicides

Rover 750ml/ha was applied on lentils at Kaniva at flowering and 2 weeks later to control botrytis grey mould and ascochyta.

Desiccation

Reglone 4L/ha.

HARVEST DATES

Table 5. Harvest dates for each of the sowing dates at field sites in 2000.

Site	Sowing date 1	Sowing date 2	Sowing date 3	Sowing date 4
Rosebery	14 November	22 November	22 November	22 November
Warne	15 November	28 November	28 November	28 November
Kaniva	12 December	12 December	12 December	12 December

STATISTICS

All results have been analysed using an ANOVA (analysis of variance). Numbers presented on graphs are the LSD (least significant difference) ($P < 0.05$) and CV (coefficient of variation) for the interaction between sowing date and variety. There was no effect of sowing depth in any of the trials.
LSD allows us to say that there is a significant difference between two treatments. If the LSD is less than the difference between two treatments, then there is a significant difference between those two treatments.
CV is an estimate of the variation across the site. If the number is larger than 20% then variation is high and it becomes more difficult to have confidence in and interpret the results.
Please contact me if you require further explanation.

RESULTS AND INTERPRETATION

Weather Summary

Rosebery and Warne (Fig. 1)

Good early rains through April meant that sowing date 1 was sown into ideal moisture. However, May and June were relatively dry, thus sowing conditions appeared worse at sowing dates 2, 3 and 4. Rainfall during winter was generally adequate. From mid September to mid October there was a dry period which caused significant stress particularly in earlier sown plots. Fortunately temperatures were cool during this period which minimised the impact of the dry conditions. Several frosts occurred which caused minor damage. From the 18th October to the 11th November 125 mm rain fell at Warne and 65 mm at Rosebery which benefited later sown plots and disadvantaged earlier sown plots. This rainfall meant that the early sown plots were harvested late and the late sown plots had to be desiccated to harvest them.

Kaniva (Fig. 2)

Sowing conditions tended to be slightly dry at the first sowing date, but were generally OK at all other sowing dates. Rainfall during winter was below average, but generally adequate and temperatures cool. Unlike Rosebery and Warne there was consistent rain throughout mid-late spring after a dry spell in August. During October there were three frosts on the 9th, 11th and 28th which caused significant seed and pod abortion, particularly in the field pea plots. Generally harvest conditions were excellent, although late sown lentil plots had to be desiccated so they could be harvested.

Soil Moisture Profiles

Graphs of soil moisture profiles are not presented as there was a high level of unexplainable variability at all sites, making it was extremely difficult to interpret the results.

The only generalisation from the data was that, soil moisture at harvest was less in the top 20 cm than at sowing. At depth (20-120cm), there were no significant differences between sowing and harvest. Water use efficiency has yet to be calculated, however it would be expected to be very low because of the late rainfall events which were likely to significantly increase soil moisture at harvest.

If you wish to see soil moisture data, please contact me directly.

Emergence, Grain Yield and Dry Weight

Rosebery - Lentils

Key points

- Sowing depth had no effect on emergence, biomass production and grain yield.
- With later sowing the emergence and dry weight at flowering was decreased whilst the grain yield increased.
- There was an interaction between sowing date and variety for grain yield, i.e. varieties performed similarly at the first three sowing dates, however at the late sowing date Nugget had the highest yields.
- Nugget was the highest yielding variety overall (1.3 t/ha compared with 1.1 t/ha for Northfield and 1 t/ha for Digger).

Detail

Final plant emergence was unaffected by sowing depth (Fig. 3a), but seed sown at 3 cm emerged 2-3 days earlier than those sown at 8 cm. Previous research has shown that shallow sowing can increase the risk of poor emergence due to post sowing, pre-emergent herbicide damage. In this trial no herbicide damage was noted, probably due to the lack of rain directly after sowing which can leach the chemicals into the root zone of the emerging crop.

Later sowing caused fewer plants to emerge of all varieties. This was likely to be related to lower soil temperature at the later sowing dates (3-5^{O}C less). Comparing varieties, Nugget generally had the highest emergence and Digger lowest. This result could be related to the seed source as varieties were obtained from different sources; Nugget was obtained from the VIDA breeding program and had excellent quality, whilst Northfield and Digger were obtained from a private company and appeared to have slightly lower seed quality.

Dry matter production at flowering showed a similar trend to plant emergence (Fig. 3c). There was no effect of sowing depth, however the dry weight was reduced by 22, 35 and 55% when plots were sown on the 24th May, 13th June and 4th July respectively compared with the 2nd May. At each sowing date there were no significant differences between varieties.

At harvest, dry matter production was similar for both depths of sowing, all sowing dates and varieties (Fig. 3d), which indicates that later sown plots were able to produce significantly greater dry matter during the flowering and podding period than early sown plots. The reason for this recovery was likely to be due to the late rainfall occurring during November. It was observed that the later sown plots were able to utilise that extra rainfall, as plants continued growing, flowering and podding, whilst the early sown plots had dried ready to harvest.

Due to this late rainfall, grain yield was generally greatest for all varieties at later sowing dates (13th June and 4th July; Fig. 3b). Within each of the first three sowing dates varieties performed similarly, however when sown on July 4th, Nugget had the highest yield and Digger had the lowest yield (less than 13th June and similar to 24th May).

Overall, results from this year should be treated with caution. Firstly, unusually late rainfall events significantly benefited later sown plots and may have reduced yield in early sown plots as they were not able to be harvested at an optimal time. Secondly, weed control was not adequate and could have reduced yields in all plots. Thirdly, seed for each variety was obtained from different sources. It has been shown in previous research that when seed of the same variety is obtained from different sources, the grain yield of plots from the different sources can show large differences, despite being the same variety. This problem will be overcome in the future by bulking seed of each variety at one site in the year prior to assessment.

Rosebery - Field Peas

Key points

- Excell had the lowest emergence.
- The highest grain yields were obtained when semi-leafless varieties (PSL4 and Snowpeak) were sown early (20-30% greater than that of later sowing and the conventional variety Dundale at all sowing dates).

Detail

Similar to lentils, total plant emergence was unaffected by sowing depth (Fig. 4a). However seed sown at 3 cm emerged 2-3 days earlier than those sown at 8 cm. No post sowing, pre emergent herbicide damage was noted. Later sowing caused fewer plants of all varieties to emerge. This was likely to be related to lower soil temperature at the later sowing dates (3-5^{O}C less). Comparing varieties, Dundale and Snowpeak had the highest emergence, approximately 20% greater than Excell. The reduced emergence in Excell was due to poorer germination (determined from germination tests) and possibly a poor seed source (from seed suppliers summer bulking of the seed).

Dry matter production at flowering was generally not affected by sowing date, although at the 2nd May and 4th July sowing dates, there were significant differences between varieties (Fig. 4c). For plots sown on the 2nd May, Dundale had the highest and Snowpeak the least dry matter and for plots sown on the 4th July Dundale had the least and Snowpeak the highest dry matter. There were no obvious reasons for this observation. Again there was no effect of sowing depth.

At harvest, dry matter production was not affected by sowing depths. However there were large differences between sowing dates (Fig. 4d). Generally plots sown on the 24th May had the greatest dry matter followed by those sown on the 2nd May, 13th June and 4th July, respectively. Excell had the least dry matter for all sowing dates, which is likely to be a result of the lower plant emergence.

Grain yield of the new semi-leafless, semi-dwarf varieties Snowpeak and Excell was significantly increased when sown early (Fig 4b). Snowpeak had grain yields 80% and 60% higher than later sowing's for the 2 May and 24 May sowing dates, respectively, whilst the yield of Excell was approximately 75% greater at the first sowing date than all other sowing dates. Dundale showed the same yield across all sowing dates, but never yielded greater than Snowpeak or Excell.

Again, this is only one year of results and thus they should be treated with caution, particularly considering the weather conditions late in the season (see Rosebery - Lentils for further reasons). However, the results do appear to clearly advocate earlier sowing of the newer varieties of field peas, such as Snowpeak and Excell.

Warne - Lentils

Key points

- Sowing depth had no effect on emergence, dry matter production or grain yield.
- Results were more variable than Rosebery, thus it was difficult to develop specific conclusions.
- There appeared to be a slight trend that with later sowing the emergence was decreased whilst the grain yield increased, which was similar to observations in lentils at Rosebery. However there were no statistically significant differences.

Detail

Similar to Rosebery, total plant emergence was unaffected by sowing depth (Fig. 5a), but seed sown at 3 cm emerged 2-3 days earlier than those sown at 8 cm. At this site there was no post sowing, pre-emergent herbicide damage, due to the lack of rain directly after sowing which can leach the chemicals into the root zone of the emerging crop. Later sowing appeared to cause a slight reduction in emergence. There were no significant differences among varieties, although Digger, sown on 13th June and Northfield sown on 4th July appeared to have lower emergence relative to other varieties.

Dry matter production at flowering showed a similar trend to plant emergence (Fig. 5c). There was no effect of sowing depth, but the dry matter was slightly reduced at later sowing dates. There were no significant differences between varieties, although Northfield appeared to have slightly greater dry matter compared with other varieties when sown on the 3rd May and 13th June.

At harvest, dry matter production was similar for both depths, however there were differences between sowing dates (Fig. 5d). The 3rd May and 13th June sowing generally had the greatest dry weight and the 23rd May sowing the lowest dry weight. No significant differences between varieties were noted.

Grain yield was generally greater at later sowing dates, similar to Rosebery, probably due to the late rainfall events (Fig. 5b). However statistical analyses indicated no significant differences between treatments and varieties.

Overall the CV's in this trial were very high indicating a lot of variability, so results need to be treated with caution. This was probably due to the weather conditions late in the season, which had a significant impact on the results, and poor weed control. Also in agronomy trials, particularly when comparing multiple treatments and varieties, there tends to be increased variation (CV) compared simpler single treatment or single variety experiments (see Rosebery - Lentils for further reasons).

Warne - Field Peas

Key points

- Sowing depth had no effect on emergence, dry matter production or grain yield.
- Later sowing reduced emergence and dry matter at harvest, but had no effect on dry matter at flowering.
- The highest grain yields were obtained when semi-leafless varieties (Snowpeak and PSL4) were sown on the 3rd May (60%-80% greater than that of 23rd May, 13th June and 4th July sowing's and the conventional variety Dundale at all sowing dates).

Detail

Total plant emergence was unaffected by sowing depth (Fig. 6a), although seed sown at 3 cm emerged 2-3 days earlier than those sown at 8 cm. No post sowing, pre emergent herbicide damage was noted. Plots sown on the 3rd May had the greatest emergence; there was no difference between the 23 May, 13 June and 4 July sowing dates. Excell had the lowest emergence at all sowing dates, due to reasons described previously (see Rosebery - field peas).

There was a significant interaction between sowing date and variety for dry matter production at flowering (Fig. 6c). PSL4 had high dry matter production for the 3rd May sowing (approximately 25% greater than all other varieties in all treatments). This was probably due to the late flowering of this variety compared with other varieties (10-15 days later), which enabled it to develop greater biomass. At later sowing dates PSL4 only flowered 5 days later than the other varieties, thus no significant differences were seen in the dry weight.

At harvest, dry matter production was not affected by sowing depths. However there were significant differences between sowing dates (Fig. 6d). Generally plots sown on the 3rd of May produced the greatest dry matter. There were no consistent differences between varieties across sowing dates, although for the 23rd May, Snowpeak appeared to have a higher dry weight than other varieties.

Grain yields of Snowpeak and PSL4 were approximately 25% greater when sown on the 3rd May compared with all other sowing dates and other varieties (Fig. 6b). Generally Excell had the lowest yield, indicative of its poorer emergence.

The CV's in this trial were very high indicating a lot of variability, thus results need to be treated with caution (see Rosebery - Lentils for further reasons). However, the results do appear to advocate earlier sowing in peas with the newer varieties similar to observations in the Rosebery trials.

Kaniva - Lentils

Key points

- Sowing depth had no effect on emergence, dry matter production or grain yield.
- Grain yields were greatest when plots were sown in the 20th June and 11th July.
- Botrytis grey mould completely decimated early sown Northfield plots.

Detail

Similar to Rosebery and Warne, total plant emergence was unaffected by sowing depth (Fig. 7a), however seed sown at 3 cm emerged 2-3 days earlier than those sown at 8 cm. At this site there was no post sowing, pre-emergent herbicide damage, again due to the lack of rain directly after sowing. Plots sown 9th May had 10-15% less emergence that those sown 31st May, 20th June and 11th July, opposite to that observed at Warne and Rosebery. At Kaniva the soil moisture was generally low at the 9th May sowing compared with sowing dates, which may have reduced the emergence. There were no significant differences among varieties.

Dry matter at flowering was significantly reduced by later sowing (Fig. 7c). There were no significant differences between varieties, although Nugget appeared to have greater dry matter compared with other varieties when sown on the 20th June.

At harvest, dry matter production was similar for both depths, all sowing dates and varieties (Fig. 7d), which indicates that later sown plots were able to produce significantly more dry matter during the flowering and podding period than early sown plots. The reason for this recovery was likely to be due to the botrytis grey mould outbreak which most severely affected early sown plots (particularly Northfield) and late rainfall occurring during November which stimulated growth in later sown plots.

Grain yield was significantly greater at later sowing dates, similar to Rosebery and Warne, probably due to the botrytis grey mould in early sown plots and late rainfall events (Fig. 7b). There were no significant differences between varieties, however Northfield plots sown 9th May had almost zero grain yield due to botrytis grey mould, compared with other varieties which yielded 0.3 to 0.4 t/ha.

Overall this trial was most severely affected with weeds and disease, thus variation is high and results need to treated with extreme caution (see Rosebery - Lentils for further reasons). Further trials are needed to clarify results observed at this site.

Kaniva - Field Peas

Key points

- Sowing depth had no effect on emergence, dry matter production or grain yield.
- Frosts during spring reduced grain yields greatly.

Detail

Total plant emergence was unaffected by sowing depth (Fig. 8a), however it was notable that seed sown at 3 cm emerged 2-3 days earlier than those sown at 8 cm. No post sowing, pre emergent herbicide damage was noted. Plots sown 9th May had approximately 30% less emergence that those sown 31st May, 20th June and 11th July, opposite to that observed at Warne and Rosebery. At Kaniva the soil moisture was generally low at the 9th May sowing compared with other sowing dates, which may have reduced the emergence. Excell again had the lowest emergence at all sowing dates, due to reasons described previously (see Rosebery - field peas).

There was a significant interaction between sowing date and variety for dry matter production at flowering (Fig. 8c). Generally PSL4 had the highest dry weight followed by Snowpeak, Dundale and Excell. This was probably due to the late flowering of this variety compared with other varieties (5-15 days later), thus it was able to develop greater biomass. Dry matter was generally reduced at later sowing dates for all varieties.

At harvest, dry matter production was not affected by sowing depths, but there was a significant interaction between sowing dates and varieties (Fig. 8d). Dundale had a significantly lower dry

weight than other varieties for the 9th May and 31st May sowing probably as it was the most susceptible to diseases.

All varieties had extremely low grain yields, probably due to frosts occurring during flowering and podding. In particular, there was a severe frost on the 11th of October with several hours below $0^{O}C$. It appeared that PSL4 was the most severely affected of the varieties (lowest yield for 31st May and 11th July sowing). This variety has a very short flowering window (up to 10 days less than other varieties), thus if a frost occurs during this period it is not able to regrow, reflower and set more pods.

The CV's in this trial were again very high indicating a lot of variability, thus results need to be treated with caution (see Rosebery - Lentils for further reasons). Further work is required to assess differences when weed control is adequate and frosts do not occur.