Variety specific management for pulses – herbicide tolerance

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The aim of this trial was to assess the relative tolerance of new cultivars of field pea, lentil and chickpea to a range of commonly used herbicides.

Summary

Trials were sown at Jil Jil in the southern Mallee and Kalkee in the Wimmera to assess the relative tolerance of new cultivars of field pea, lentil and chickpea to a range of commonly used herbicides. Results indicate that herbicide management practices may need to be slightly modified in many instances for new ascochyta blight resistant chickpeas to maximise the yield benefits of these new cultivars. For field peas and lentils, each of the new cultivars tested performed similar to or better than current cultivars in terms of their herbicide tolerance and/or yield.

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 and field observations have indicated that pulse cultivars can vary widely in their response to herbicide application. The research presented here focuses on the development of management packages for these new cultivars to optimise yield and quality. Field trials conducted during 2003 compared the effect of commonly used herbicides on the performance of two recently released or potential cultivars of peas, one of lentil and up to five chickpeas with currently grown cultivars (These trials did not aim to assess the relative efficacy of these chemicals to control weeds). 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 June 3 at Jil Jil in the southern Mallee (John Ferrier's farm; approx 20km north of Birchip) and July 18 at Kalkee in the Wimmera (TLC field day site) to compare cultivars of field pea, lentil and chickpea. The experiment was designed as a split plot with 3 replicates (i.e. cultivars were randomized within each replicate of herbicide).

Treatments and design

Herbicides

All herbicides were applied at label and double label rates. Glean was included at a low rate to mimic residual effects. Sulfonurea herbicides applied in preceding cereal crops can have residual effects on following pulse crops.

Table 1. Herbicide treatments and their application timing and rate (per ha) to field peas, lentils and chickpeas pulses at Jil Jil and Kalkee in 2003.

Treatment	Application Timing[1]	Field Peas	Lentils	Chickpeas
Control				
Glean	IBS	2g	2g	2g
Trifluralin x1	IBS	1.5L	1L	1.5L
Trifluralin x2	IBS	3.0L	2L	3.0L
Simazine x1	PSPE		1.0L[2]	1.0L
Simazine x2	PSPE		2.0L[2]	2.0L
Spinnaker x1	PSPE	200mL		
Spinnaker x2	PSPE	400mL		
Lexone x1	PSPE	280g	280g	280g
Lexone x2	PSPE	560g	560g	560g
Diuron x1	PSPE	1.2L	1.2L	
Diuron x2	PSPE	2.4L	2.4L	
Simazine + Lexone x1	PSPE		1L + 120g	
Simazine + Lexone x2	PSPE		2L + 240g	
Simazine + Spinnaker x1	PSPE			1L + 125mL
Simazine + Spinnaker x2	PSPE			2L + 250mL
Simazine + Diuron x1	PSPE			0.8L + 0.8L
Simazine + Diuron x2	PSPE			1.6L + 1.6L
Simazine + Balance x1	PSPE			1L + 100g
Simazine + Balance x2	PSPE			2L + 200g
Raptor x1	4 node	45g		
Raptor x2	4 node	90g		
Brodal x1	4 node	150mL	150mL	
Brodal x2	4 node	300mL	300mL	
Broadstrike x1	4 node	25g	25g	25g
Broadstrike x2	4 node	50g	50g	50g
Verdict x1	Z14 weeds	75ml	75ml	75ml
Verdict x2	Z14 weeds	150ml	150ml	150ml

1. IBS - applied immediately after sowing and harrowed in; PSPE – applied post sowing pre-emergence; 4 node – applied at the 4 node stage of crop growth; Z14 weeds – applied at the Z14 stage of grass weed growth.
2. At Kalkee Simazine® x1 – 1.5L, Simazine® x2 – 2.0L.
Note: Exact details of chemicals used (e.g. active ingredients, manufacturer etc.) can be supplied upon request.

Cultivars

Field peas sown at Birchip and Kalkee include Kaspa, Parafield, Snowpeak, Sturt and Dundale.

Lentils sown at Birchip and Kalkee include Nugget, Northfield and CIPAL102.

Chickpeas sown at both Birchip and Kalkee include Howzat, ICCV96836, Flip 94-508c, Flip 94-00c, Kaniva, S95342, Sona-4019.

Paddock management

Grain legume mix with 2% zinc at 60 kg/ha at Jil Jil and 80 kg/ha at Kalkee was applied with seed at sowing. Weeds prior to sowing were controlled using a pre-sowing knockdown herbicide. Where possible, no in-crop herbicides were applied, other than the herbicide treatments as indicated. At Kalkee, due to an excessive weed burden after application of treatments, post emergent broadleaf and grass herbicides were applied. Fungicides were applied to lentil and chickpea trials to prevent fungal diseases. Insect pests were controlled using insecticides as required.

Measurements and analysis

At approximately the 11-12 node growth stage in field peas and 9 node in chickpeas (13 weeks after sowing at Jil Jil and 17 weeks after sowing at Kalkee) plots were scored for herbicide damage symptoms. Lentils were not scored at either site as there were no significant herbicide damage symptoms.

During the season scores of weed pressure (1 – no weeds, 5 – high weed population) were recorded on lentil and chickpea plots at Kalkee. Bacterial Blight was observed in field pea plots at Kalkee. Symptoms were scored (1 – no bacterial blight; 9 – complete death). All plots were harvested and grain yields recorded. At Jil Jil, due to the dry conditions, grain yields were too low to be analysable and are not presented in this report.

Results

Jil Jil

Field peas

Emergence and growth throughout the season appeared adequate, but an extremely dry finish resulted in low grain yields (0.3-1 t/ha; data not shown).

All herbicide treatments except Diuron® x1 and x2, Trifluralin x1, Spinnaker® x1 and Verdict® x1 and x2 caused significant symptoms and/or crop damage on at least one of the cultivar grown. Herbicide treatments that caused the worst effects were: Lexone® x2 caused moderate to heavy damage on Kaspa, Parafield and Sturt (scores of 6-8), but only moderate to severe symptoms on Dundale and Snowpeak. Raptor® x2 affected all cultivars, being most severe on Parafield and Dundale (scores of 4.5 – 5). Broadstrike® at both x1 and x2 caused slight to moderate symptoms on all cultivars, including stunted growth and delayed flowering. By pod fill all cultivars had recovered from herbicide symptoms.

Sturt was the only cultivar that consistently produced any grain yield (data not shown).

Chickpeas

Emergence was adequate, but growth throughout the season appeared slow. Weed competition was a major limitation to growth. The extremely dry finish to the season combined with weed pressure resulted in extremely low yields (< 0.5t/ha; data not shown).

There was no significant interaction between cultivar and herbicide treatment for herbicide score, however each of the main effects was significant, i.e. all cultivars performed similarly within each herbicide treatment. All herbicide treatments caused significant symptoms. The Simazine® + Spinnaker® and Simazine® + Balance® treatments caused the worst symptoms. Most of the x2 treatments for each of the chemicals resulted in scores greater than 3 (slight-moderate symptoms).

Averaged across all herbicide treatments Kaniva had the lowest score and Flip 94-508c and Howzat the highest scores (Table 2). All cultivars recovered from herbicide symptoms by pod fill.

Table 2. Average grain yield (t/ha) of the chickpea cultivars across all herbicide treatments at Jil Jil.

	Flip 94-508c	Howzat	ICCV96836	Kaniva
Herbicide score	3.1	2.9	2.5	2.2

LSD $_{(P<0.05)}$ 0.3

Kalkee

Field peas

Emergence and growth throughout the season was generally good. Bacterial blight was noted in the trial after two frost events in late September. This was scored and has been used as a covariate in the grain yield analysis. Generally, Snowpeak was most susceptible and Sturt, Parafield and Dundale most tolerant to bacterial blight infection (data not shown). Weed competition limited growth and was controlled with a broadleaf specific spray late in the season. There was dry finish to the season which resulted in grain yields lower than expected.

For both herbicide score and grain yield at Kalkee there were significant differences among herbicide treatments (when averaged across all varieties), and varieties (when averaged across all herbicide treatments). The most significant herbicide damage and lowest yields were generally recorded for the Glean®, Broadstrike® and Raptor® treatments. The control treatment was also low yielding. Most other herbicide treatments caused almost no significant symptoms. The highest grain yields were recorded in the Trifluralin x 1 and Spinnaker® x1 treatments.

Sturt averaged the lowest herbicide score and highest grain yield across all herbicide treatments Snowpeak had the highest herbicide score, but Dundale had the lowest grain yield (Table 3). All cultivars recovered from herbicide symptoms by pod fill.

Table 3. Average herbicide score and grain yield (t/ha) of field pea cultivars across all herbicide treatments at Kalkee.

	Dundale	Kaspa	Parafield	Snowpeak	Sturt
Herbicide score	1.5	1.4	1.5	1.7	1.3
Grain yield (t/ha)	1.37	1.79	1.79	1.56	1.94

LSD $_{(P<0.05)}$ Herbicide score - 0.2; Grain yield - 0.25

Lentils

Emergence and growth throughout the season was generally good. Weed competition was a major limitation to growth and had to be controlled with a broadleaf specific spray late in the season. Weed populations were scored and data used as a covariate in the grain yield analysis (data not shown). The dry finish to the season resulted in grain yields lower than expected.

None of the herbicides caused significant symptoms on the cultivars used in the trial this year. However there were significant differences among herbicide treatments when averaged across all varieties and varieties when averaged across all herbicide treatments for grain yield. The highest grain yields (1.5 – 1.8t/ha) were recorded in the Simazine®, Lexone® and Simazine® + Lexone® treatments. Yields less than 1 t/ha were recorded for the Glean® and Brodal® x2 treatments.

Nugget had approximately 25% higher grain yields than Northfield or CIPAL 102 (Table 4).

Table 4. Average grain yield (t/ha) of lentil cultivars across all herbicide treatments at Kalkee.

	Nugget	Northfield	CIPAL 102
Grain yield (t/ha)	1.55	1.18	1.12

LSD $_{(P<0.05)}$ 0.11

Chickpeas

Emergence and growth throughout the season was generally good. Weed competition was a major limitation to growth and had to be controlled with a broadleaf specific spray late in the season. Weed populations were scored and data used as a covariate in the grain yield analysis (data not shown). There was dry finish to the season and this combined with weed competition resulted in grain yields lower than expected.

For both herbicide score and grain yield at Kalkee there were significant differences among herbicide treatments, when averaged across all varieties, and varieties, when averaged across all herbicide treatments. Broadstrike® treatments resulted in the most significant herbicide damage and lowest grain yields. Most other herbicide treatments caused slight symptoms. The highest grain yields were recorded in the Simazine® + Balance® treatments and the Simazine® x2 treatment.

Sona-4019 averaged the highest herbicide score and equal lowest grain yield (with S9342) across all herbicide treatments. It appeared that Sona-4019 was more sensitive to Simazine® or Simazine® mixes than other cultivars (scores > 2 compared with < 2 for all other cultivars; Data not shown). Kaniva had the lowest herbicide score, but Flip 94-90c the highest grain yield (Table 5). All cultivars recovered from herbicide symptoms by pod fill.

Table 5. Average grain yield (t/ha) of chickpea cultivars across all herbicide treatments at Kalkee.

	Flip 94-508c	Flip 94-90c	Howzat	ICCV96836	Kaniva	S95342	Sona-4019
Herbicide score	1.5	1.5	1.6	1.3	1.2	1.4	2.0
Grain yield (t/ha)	0.63	0.83	0.68	0.74	0.57	0.41	0.44

LSD $_{(P<0.05)}$ Herbicide score - 0.2; Grain yield - 0.10

Interpretation

General

- Weed competition limited grain yield and was the main reason why control treatments had lower yields than herbicide treatments. Further research in this area is needed to reassess how to best manage weeds that appear during the season.
- Differences in herbicide scores between sites are probably related to differences in soil type. Kalkee was the traditional Wimmera alkaline black cracking clay, while the Jil Jil site was an alkaline sandy loam.

Field Peas

- Both new cultivars (Kaspa and Sturt) appear to have adequate tolerance to the range of herbicides used in this experiment. Sturt was the highest yielding cultivar at both sites.

Lentils

- Although no major visual symptoms of herbicide damage were apparent, there were some significant differences in grain yield. All lentil cultivars used were very sensitive to the Glean herbicide treatment.
- Results highlighted that early weed control is critical in lentils. All treatments that resulted in highest grain yields were applied post sowing pre emergence.
- Although not obvious from these trials, other trials indicate that CIPAL 102 will have similar tolerance to herbicides to Northfield.

Chickpeas

- Kaniva, although very sensitive to ascochyta blight, is a good standard for herbicide tolerance. In both trials it had the lowest herbicide scores.
- Grain yields for chickpeas this year were low due to the dry finish and weed competition.

Commercial Practice

Field Peas

- Kaspa and Sturt had good tolerance to the range of chemicals used in this trial in 2003.
- Where possible it is desirable to avoid the use of post emergent chemicals, however if they are needed, Brodal® appeared to cause the least damage.

Lentils

- If CIPAL 102 is released as a cultivar it will need to be managed from a herbicide perspective in a similar way to Northfield.
- Early weed control is critical for adequate grain yields.

Chickpeas

- Further research is needed before adequate conclusion can be made, but it is likely that some of the new ascochyta blight resistant chickpea released over the coming years will be slightly more sensitive to some herbicide applications than other cultivars.