Lucerne production following residual herbicides used in northern cropping systems

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Summary Lucerne (*Medicago sativa* L.) is finding an increasing role in dryland farming systems of the grain region of northern New South Wales and Queensland as a ley legume to improve soil fertility, grain yield and quality. Residual herbicides play an essential role in weed management in crop rotations in this region, although their persistent residues may damage the susceptible crops sown following their use. Experiments were conducted on two soil types to test the effects of application time of residual herbicides (winter and summer) on the survival and production of lucerne sown in the following autumn/winter.

The effect of the herbicides on initial seedling growth varied with herbicide, rate of application and soil type. Seedling establishment was not affected. Reduced seedling vigour and phototoxicity were evident in some treatments. However, irrespective of seedling response, the lucerne recovered with no subsequent reduction in dry matter production at any site at the first cut taken 5 months after sowing.

Keywords Lucerne, residual herbicides, plantback, vertosol, sodosol.

INTRODUCTION

Residual herbicides provide cost effective weed control in the northern grain belt. In a recent survey, 21% of growers believed that residues of herbicides used in the preceding crops had affected their lucerne establishment (Storrie and Cook pers. comm.). Consequently, residual herbicides are considered by growers to be a limiting factor in more widespread adoption of lucerne in rotations.

The residual herbicides, chlorsulfuron, clopyralid, metsulfuron-methyl, triasulfuron and picloram + 2,4-D (Tordon 75-D), are important tools in the management of weeds in winter cereal crops, while atrazine, imazethapyr, imazapic, metsulfuron-methyl and picloram + 2,4-D are used to control summer weeds.

Recommended plantback times for these herbicides for lucerne vary from nine to 24 months for the winter applied herbicides and from nine to 18 months for the summer applied herbicides. However, seasonal sowing opportunities for lucerne may occur approximately eight to 12 months and six to nine months following application of winter and summer-applied residual herbicides, respectively. Currently, there is limited information available on the effects of residues of these herbicides on the production of lucerne pastures sown earlier than the recommended plantback periods. This paper presents data from four experiments where lucerne was sown at different intervals following application of a range of winter and summer-applied residual herbicides.

MATERIALS AND METHODS

In July 1997, chlorsulfuron, metsulfuron-methyl, and triasulfuron were applied at Goondiwindi (trial 1), Roma (trial 2) and Warra (trial 3) in southern Queensland. In 1998, chlorsulfuron, metsulfuron-methyl, triasulfuron, clopyralid, and picloram + 2,4-D were applied in August, and metsulfuron-methyl, atrazine, imazapic, imazethapyr and picloram + 2,4-D were applied in December at Goondiwindi (trial 4) and Warra (trial 5) (Table 1). Herbicides were applied at the recommended and double rates (Table 2) to weed-free fallow plots. Soils were either sodosols (trials 1 and 4) or vertosols. Between spray application and planting, plots were hand weeded after significant rainfall events.

Lucerne cv. Trifecta was sown during April/May 1998 in trials 1–3 and in June 1999 in trials 5–6. Establishment was good at all sites. However, trial 1 was abandoned after three months due to drought. The other trials received adequate rainfall.

Table 1. Soil type, date of herbicide application and plantback period between spraying and sowing of lucerne for each trial

Trial	Soil type	Herbicide applied	Plantback (months)
1	Sodosol	17/7/97	9.3
2	Vertosol	8/7/97	10.5
3	Vertosol	9/7/97	10.6
4	Sodosol	12/8/98	10.6
		8/12/98	6.5
5	Vertosol	3/8/98	10.6
		7/12/98	6.5

Table 2. Phytotoxicity ratings, where 0 = no effect, 1–2 = minor effects, 3–4 = severe effects, and 5 = extreme effects and plant death. Ratings were at three weeks after lucerne emergence.

Herbicide	Rate (product ha^{-1})	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Control						
Metsulfuron-methyl (winter)	7 g	1	0.5	0	0.5	0
Metsulfuron-methyl (winter)	14 g	1	1	0.5	1	0
Chlorsulfuron	20 g	1.5	1	1	2	0
Chlorsulfuron	40 g	2.5	2	2	3	1
Triasulfuron	35 g	1	1	1	0.5	0
Triasulfuron	70 g	2	2	2	2	0
Clopyralid	300 mL				0.5	0
Clopyralid	600 mL				0.5	0
Picloram/2,4-D (winter)	300 mL				0	0
Picloram/2,4-D (winter)	600 mL				0.5	0
Metsulfuron-methyl (summer)	7 g				1	0
Metsulfuron-methyl (summer)	14 g				3	1
Atrazine	2 kg				1	0
Atrazine	4 kg				1	0
Imazapic	200 mL				4	0
Imazapic	400 mL				4	2
Imazethapyr	300 mL				2	0
Imazethapyr	600 mL				4	2
Picloram/2,4-D (summer)	1 L				1	0
Picloram/2,4-D (summer)	2 L				0.5	0

Plots were rated for herbicide damage using a 0–5 scale, where 0 = no damage and 5 = plant death, at approximately three weeks after lucerne emergence (Table 2). Five months after sowing, a sample area of 2.2 m^2 per plot was cut by mower and dry weights determined. The harvest data were subjected to analysis of variance (Table 3).

RESULTS

In trials 1, 2 and 3, initial seedling growth and vigour was slightly retarded and limited phytotoxicity was observed in plots treated with chlorsulfuron and triasulfuron at double rates (Table 2). Symptoms, which included stunting and chlorotic leaves, were slightly more marked in trial 1 (sodosol soil). No plant deaths were recorded in any treatments. Only minor symptoms were observed in metsulfuron-methyl treated plots.

In trial 4 (sodosol soil), severe phytotoxic symptoms were recorded in plots treated with imazethapyr at 600 mL ha^{-1} and imazapic at both rates. Symptoms included stunting and developmental setback, chlorotic and purpling of trifoliate leaves with limited necrosis on leaf margins but no plant death. Similar but lesser symptoms were also noted in plots treated with the double rate of both chlorsulfuron and summer-applied metsulfuron-methyl (Table 2).

Minor symptoms were observed at trial 5 (vertosol soil) in the imazethapyr and imazapic plots at double rates (Table 2).

Phytotoxicity symptoms did not persist past three months at any of these five sites.

At all harvested sites, lucerne production at five months after sowing was either the same or greater in the treated plots than in the untreated plots (Table 3).

DISCUSSION

Previous research has shown crop responses to herbicide residues varied with different soil types (Barnes *et al.* 1996, Dunmall *et al.* 1996). Herbicide residues adversely affected crops grown in sodosol soils more than in other soil types. Similarly, Churchett *et al.* (1999) found lucerne grown under glasshouse conditions was more affected by sulfonylurea herbicide residues in sodosol soil than in vertosol soil.

In this study, only residues of chlorsulfuron, imazethapyr, imazapic and summer-applied metsulfuron-methyl, present in the sodosol soil produced severe phytotoxic symptoms in lucerne. These symptoms occurred at only one site and at double the recommended rates, except for imazapic with severe symptoms at both rates. At all sites, no or only minor phytotoxic symptoms were observed following triasulfuron at recommended rates, and atrazine, clopyralid,

Table 3. Lucerne shoot dry matter (kg ha^{-1}) at five months after sowing

Herbicide	Rate (product ha^{-1})	Trail 2	Trial 3	Trial 4	Trial 5
Control		898	1518	1512	890
Metsulfuron-methyl (winter)	7 g	804	1380	1342	1052
Metsulfuron-methyl (winter)	14 g	897	1423	1602	1142
Chlorsulfuron	20 g	1152	1487	1436	1206
Chlorsulfuron	40 g	1002	1347	1504	1154
Triasulfuron	35 g	1027	1531	1491	1197
Triasulfuron	70 g	937	1464	1517	1180
Clopyralid	300 mL			1589	1035
Clopyralid	600 mL			1470	1377
Picloram/2,4-D (winter)	300 mL			1580	1129
Picloram/2,4-D (winter)	600 mL			1525	1069
Metsulfuron-methyl (summer)	7 g			1559	1048
Metsulfuron-methyl (summer)	14 g			1674	1103
Atrazine	2 kg			1495	1167
Atrazine	4 kg			1652	1180
Imazapic	200 mL			1695	1022
Imazapic	400 mL			1350	1022
Imazethapyr	300 mL			1610	1172
Imazethapyr	600 mL			1661	988
Picloram/2,4-D (summer)	1 L			1529	886
Picloram/2,4-D (summer)	2 L			1585	1178
LSD (P=0.05)		ns	ns	ns	159

picloram + 2,4-D (summer and winter) and winter-applied metsulfuron-methyl at any rate. However in all trials, regardless of some severe seedling responses, symptoms disappeared in three months and lucerne dry matter yields were not significantly affected by any treatment at the first cut taken five months after sowing.

The results from this preliminary research show that, while herbicide residues from previous crops may adversely affect lucerne seedlings initially, the crop recovers without loss of production. From these results, sowing lucerne following residual herbicides appears more flexible than stated in the current plantback recommendations for southern Queensland, particularly for vertosol soils.

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REFERENCES

Barnes, J.E., Walker, S.R., Dunmall, T., Osten, V.A., Hargraves, P.A., Noble, R.M. and Churchett, J.D. (1996). Wheat and chickpea response to summer applied herbicides in central and southern Queensland. Proceedings of the 11th Australian Weeds Conference, Melbourne Victoria, pp 53-55.

Churchett, J.D., Walker, S.R. and Lloyd, D. (1999). Lucerne seedling responses to residual herbicides used in grain farming systems. Proceedings of the 12th Australian Weeds Conference, Hobart, Tasmania, p 273.

Dunmall, T., Walker, S.R., Barnes, J.E. and Churchett, J.D. (1996). Cropping options following winter applied herbicides in southern Queensland. Proceedings of the 11th Australian Weeds Conference, Melbourne, Victoria, pp 36-38.