Differential tolerance of lupin cultivars (*Lupinus angustifolius*) to triazine herbicides

J.A Cooper and D.G Bowran
Western Australian Department of Agriculture
Baron-Hay Court, South Perth, 6151

Summary
Significant variation in s-triazine tolerance between cultivars of narrow leaf lupins (*Lupinus angustifolius*) has been shown. Of the current cultivars, Gungurru was tolerant while Danja was sensitive to field rates of simazine. The use of tolerant cultivars will permit the application of higher rates of simazine to control problem weeds in the field.

Introduction

The s-triazine herbicides, simazine and atrazine, are routinely applied to lupin (*Lupinus angustifolius*) crops in Western Australia (WA) immediately prior to seeding to control the majority of weeds. The application of higher than recommended rates of simazine has been shown to remove all problem weeds, including doublegees (*Emex australis*), which are often poorly controlled at recommended rates. However the tolerance of current cultivars has been a barrier to increasing application rates as yield depression can occur even at recommended rates in unfavourable conditions. Crops grown in moist, sandy textured soils are most vulnerable.

Variations in herbicide sensitivity between cultivars have been found in many plant species. Varietal differences in triazine sensitivity have been shown in soybeans (4) and oilseed Brassicas (3) As lupins are a recently domesticated crop, and have a diverse genetic background the likelihood of variability between cultivars could be expected to be high.

This paper presents information on relative tolerances of current cultivars grown in two years of herbicide tolerance trials in WA. Of these the cultivars Danja and Gungurru are grown on 85% of the area sown to lupins in WA.

Method

The cultivars were grown as part of herbicide tolerance experiments at East Beverley and East Chapman in 1990, and East Chapman in 1988. The East Chapman site is a deep yellow sand with low organic matter and low clay content (Uc5.22) in the northern edge of WA wheat belt. Simazine damage commonly occurs on this soil type. The East Beverley site has a loamy, duplex soil (Dy2.82). The experiments were a randomised block in 1988 and a split block design in 1990.

A range of simazine rates of 0.5 to 4.0 kg ha^{-1}ai were applied in 1990 immediately prior to seeding. The seeding rate was 100 kg ha^{-1} with 10 kg P ha^{-1} applied at seeding.

The four registered cultivars: Gungurru, Danja, Yorrel and Merritt were used in all the experiments with an old cultivar Illyarrie in 1988 and two new breeders lines in 1990.

The raw data was analysed by a nearest neighbour technique (Spatial Analysis of Field Experiments (1)) prior to analysis of variance. The slopes of linear regressions fitted to the response curves were compared for the 1990 experiments. This provides an indication of tolerance with the flatter slopes being the more tolerant cultivars.

Results

Cultivar differences in tolerance to simazine were identified at East Chapman in 1988 (Table 1). Gungurru was more tolerant than the other cultivars used and significant yield loses did not result at any rate up to 2.25 kg, but at the 3.0kg ha^{-1}ai rate the yield was depressed. The line CE2/435 was intermediate in tolerance while there was little difference between Yorrel, Illyarrie and Danja which could all be considered sensitive to simazine. The recommended rate of simazine on this soil type is 0.75 kg ha^{-1} so cultivars were assessed at double or greater rates.

Table 1 Yields of five lupin cultivars treated with simazine at East Chapman, 1988 expressed as percentage of untreated control

Simazine kg ha^{-1}ai	Gungurru	CE2/435	Yorrel	Illyarrie	Danja
1.5	100	95	96	87	84
2.25	106	86	70*	68*	50*
3.0	81	53*	50*	46*	45*

* significantly different from untreated at 95% level of confidence

The 1990 experiments showed a similar tolerance pattern (Table 2,3) At both sites Gungurru was the cultivar most tolerant to simazine, though at East Chapman the line 75A/330 was equivalent. Yorrel and Danja were the most sensitive cultivars at both sites. Merritt and CE2/435 were intermediate in sensitivity but the variability of Merritt at East Chapman was too high to show a significant difference from any other cultivar.

Table 2 Regression parameters for six lupin cultivars treated with simazine rates of 0.5 to 4.0 kg ha^{-1} ai at East Chapman, 1990

cultivar	intercept	slope	#	s.e. slope	r2
75A/330	104.37	-1.36	a	0.828	0.351
Gungurru	100.47	-1.86	a	0.544	0.701
Merritt	90.25	-3.12	abc	1.498	0.464
CE2/435	99.78	-3.31	b	0.374	0.94
Danja	97.55	-4.23	c	0.331	0.92
Yorrel	94.17	-5.75	c	0.611	0.947

cultivars with same suffix are not significantly different at 90% level of confidence

Table 3 Regression parameters for four lupin cultivars treated with simazine rates of 0.5 to 4.0 kg ha^{-1} at East Beverley, 1990

cultivar	intercept	slope	#	s.e. slope	r^2
Gungurru	126.06	-2.53	a	2.274	0.24
Merritt	124.20	-4.88	b	1.372	0.70
Yorrel	125.49	-6.10	bc	0.933	0.91
Danja	125.41	-7.87	c	0.751	0.96

cultivars with same suffix are not significantly different at 95% level of confidence

The intercept at East Beverley does not pass through 100% since there were some weeds present at this site so low rates of simazine improved yields equally across cultivars.

Discussion

The results presented show that there were consistent differences in simazine tolerance between cultivars. Those examined can be grouped into tolerant (Gungurru, 75A/330), intermediate (Merritt, CE2/435) and sensitive (Yorrel, Danja & Illyarrie).

It is possible to control problem weeds in lupin crops by using higher than currently recommended rates of simazine if the tolerant cultivar Gungurru is sown. This result has been successfully incorporated into current experiments investigating methods of controlling doublegees in lupin crops (Gilbey, pers. comm.) Soil carryover into following cereals has not been a problem and is unlikely to result from moderate increases in herbicide rates

The variation in triazine tolerance was expected from a group of cultivars with diverse genetic background. Illyarrie (sensitive) was a parent of both Yorrel (sensitive) and Gungurru (tolerant) so Gungurru could have derived its triazine tolerance from the wild line or recombination of genes from both Illyarrie and the wild line. While Merritt is a reselection from Gungurru (at F7), it has lower tolerance to triazines than Gungurru.

There is variation between experiments in the actual yield reduction due to variations in environmental conditions. As simazine is a soil active herbicide its activity depends on the interaction between soil moisture levels and organic matter and clay contents (2). The recommended rates at each site are linked to the clay content hence the East Chapman site has a lower recommended rate of simazine application (0.75 kg ha^{-1}ai) because there is a lower clay (3%) and organic matter content, whereas the recommended rate needed at East Beverley is higher (1.0 kg ha^{-1}) due to higher clay (6%) and silt contents.

While more simazine damage is usually found at East Chapman due to sandier soils, in 1990 the slopes of the regressions show that damage was worse at East Beverley. This may be due to the higher soil moisture levels as duplex soils in WA often have waterlogging for periods of up to 8 weeks after seeding. Soil moisture levels have been shown to increase simazine activity(2).

Acknowledgements

This research was part of a project jointly funded by the Grain Legume Research Council of Australia and Grain Legumes Committee. We thank N Thomson for technical assistance.

References

1.Cullis, B., Gleeson, A. and Lill, W.(1989) 'Safe Manual'. NSW Dept. of Agric. and Fish.

2.Gunther, F.(1970) The Triazine Herbicides. *Residue Rev*, 32,413-30

3.McGuire, G.M.(1988) Physiological genetics of simazine tolerance in the oilseed Brassicas. Ph.D Thesis, Agric., University of Western Australia

4.Weese, W.W. de., Wax, L.M., Carlson, W.C. and Ciarletta J.A. (1989) Response of soybean (*Glycine max*) cultivars to metribuzin in the field and greenhouse. *Weed Technology* 3(4),566-72