TOLERANCE OF *LUPINUS ALBUS* TO HERBICIDES

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Summary The tolerance of *Lupinus albus*, (cv. Kiev Mutant) to a range of pre-seeding and post-emergent herbicides was examined in field trials in Western Australia. Kiev Mutant showed limited tolerance to simazine applied before seeding, with yield reductions occurring at twice the normal use rates. Diuron applied pre-emergence of the crop was safe on Kiev Mutant. Of the post-emergent options only metosulam was considered to have good crop safety. Diflufenican, simazine + diflufenican and metribuzin + diflufenican all showed crop phytotoxicity at one or more sites and this was often associated with yield reductions. The implications for herbicide use in this crop are discussed.

INTRODUCTION

In Western Australia the species *Lupinus albus* (cv. Kiev Mutant) is currently grown on about 2–3% of the area sown to lupins. However it is locally important in some areas for its better adaptation to some soil types and for higher premiums paid for its grain. In recent years reports of herbicide damage were received from growers in northern regions around Geraldton. These reports indicated that herbicides such as simazine and diflufenican were causing unacceptable phytotoxicity when the herbicides were applied early post-emergence. Adamczewski and Paszkiewicz (1988) reported yield increases with the use of simazine 0.75 kg ha^{-1}, but this was still below the best yields obtained with cyanazine. Feyler and Mitich (1986) also indicated that simazine caused injury to albus lupins in high rainfall situations in California.

The aim of the experiments reported here were to confirm if currently registered herbicides for use in lupins did cause damage to Kiev Mutant and if this damage resulted in yield reductions.

MATERIALS AND METHODS

Experiments were set up in 1994 at two farmer sites in the Geraldton region (Ellendale Pool and Chapman Valley) and one herbicide tolerance site in the Southern region (Katanning), while in 1995 experiments were conducted on two herbicide tolerance trials at Mullewa and Katanning. The soil types for the Geraldton and Mullewa sites were slightly acid red loams while the Katanning sites were acid duplex (grey sandy loam over clay at 30 cm). The Ellendale Pool soil also contained ironstone gravel to about 20% of the soil volume. The Ellendale Pool site received an application of haloxyfop at 32.5 g a.i. ha^{-1} to control wild oats (*Avena fatua*) and ryegrass (*Lolium rigidum*). Herbicide treatments were applied as shown in Tables 1 and 2. Assessments of phytotoxicity symptoms were taken four weeks after application and all treatments were taken to harvest.

RESULTS

Phytotoxicity symptoms varied considerably between sites. The Ellendale Pool site showed severe symptoms of simazine and diflufenican damage and recovery was very slow to occur. For both herbicides, marginal to complete leaf necrosis and leaf shedding was evident with any treatment containing these active ingredients. In contrast metribuzin applied after seeding but before emergence had few effects on the crop with only occasional plants showing leaf necrosis. The effect of metosulam on the Kiev Mutant was atypical of symptoms seen at other sites and was evident as areas of leaf necrosis within the leaflet. This was subsequently diagnosed as zinc deficiency and could be confused with simazine phtytotoxicity. These symptoms were also present in other treatments but to a lesser degree.

At the Chapman Valley site symptoms of phytotoxicity were restricted to the double rate of simazine, diflufenican alone and the two post-emergent treatments containing simazine. Levels of damage were relatively minor with small a mounts of leaf blotching with diflufenican. However reductions in crop biomass were seen with the double rate of simazine up to flowering.

In the 1995 season, symptoms of damage from registered herbicide were most obvious with treatments containing diflufenican. The combination of metribuzin + diflufenican was particularly severe with almost complete defoliation of the crop at both sites. Metosulam showed no symptoms of crop effect apart from a slightly darker green colouring.

The yields obtained from the experiments support the view that Kiev Mutant has marginal tolerance to recommended herbicides for lupins. The Ellendale Pool site in particular highlights the extent of yield loss which can occur (Table 1). In contrast the Chapman Valley site showed slight yield increases, possibly as a result of some grass weed control by the simazine applied before seeding. Significant yield differences were still present and both diflufenican and simazine + diflufenican were reduced in yield compared to the standard simazine pre-seeding treatment.

The results from Katanning in 1994 and the two 1995 sites (Table 2) further support the view that sensitivity to difufenican and simazine + difufenican may limit yields of Kiev Mutant. Metribuzin and its combination with difufenican is particularly severe on Kiev Mutant with very large yield losses seen. Yields with metosulam were good in the larger tolerance screens reported in Table 2.

Diuron applied after seeding did not cause further yield reduction over that caused by the simazine applied before seeding or immediately after seeding (Table 1, Table 2).

Table 1. Yield of Kiev Mutant lupins (expressed as per cent of untreated) treated with lupin herbicides at Chapman Valley (CV) and Ellendale Pool (EP) in 1994.

Treatment (rate ha^{-1}, timing)	EP 94	CV 94
Yield t ha^{-1} (untreated)	0.74	1.47
simazine (1.0 kg IBS)	80	114
simazine (2.0 kg IBS)	47	103
metribuzin (0.225 kg PSPE)	101	115
simazine + diuron (1.0 kg + 1.0 kg PSPE)	74	113
simazine (0.5 kg 3lf)^A	83	107
diflufenican (0.1 kg 3lf)^A	75	105
metosulam (0.007 kg 3lf)^A	45	114
simazine + diflufenican (0.5 kg + 0.005 kg 3lf)^A	51	101
LSD (% of untreated, P=0.05)	32	7

^{A} treatments which received 1.0 kg ha^{-1} simazine IBS.

Table 2. Yield of lupins (expressed as per cent of untreated) at Katanning in 1994 and 1995 and at Mullewa in 1995.

Treatment (rate ha^{-1}, timing)	Katanning 1994	Mullewa 1995	Katanning 1995
Yield t ha^{-1} (untreated)	0.6	1.11	0.73
simazine (1.0 kg IBS)	117	90	103
simazine (2.0 kg IBS)	112	85	79
diuron (1.0 kg PSPE)	136	98	102
simazine (0.5 kg 3lf)^A	118	–	–
diflufenican (0.1 kg 3lf)^A	127	84	78
simazine + diflufenican (0.5 kg + 0.005 kg 3lf)^A	85	84	77
metribuzin (0.150 kg PSPE)^A	81	59	35
metosulam (0.005 kg 3lf)^A	128	94	94
metribuzin + diflufenican (0.1 kg + 0.005 kg 3lf)^A	89	78	27
diflufenican + metosulam (0.075 kg +0.005 kg 3lf)^A	123	94	112
LSD (% of untreated, P=0.05)	24	12	32

^{A} treatments which received 1.0 kg ha^{-1} simazine IBS.

DISCUSSION

The results of the experiments reported here support the view that Kiev Mutant has marginal tolerance to a range of recommended herbicides used in lupins, and is consistent with the view expressed by farmers that herbicide damage can occur on this variety in the Geraldton region.

The standard application of simazine at 1.0 kg ha^{-1} was generally safe on Kiev Mutant but did cause crop effects and yield reduction at the Ellendale Pool site. A reduction in use rates on similar soil types may be warranted but only if weed control is not compromised. A previous albus lupin variety grown in Western Australia (cv. Ultra) was considered to be highly sensitive to simazine and a maximum use rate of 0.5 kg ha^{-1} was the recommendation for pre-seeding weed control with Ultra (Gilbey personal communication). Applying diuron to the crop at pre-emergence timings with simazine at normal rates did not enhance the crop damage and such an option can be useful to gain additional control of weeds such as doublegee (*Emex australis*).

Diflufenican symptoms were present on Kiev Mutant at most sites and yield reductions were recorded in some cases. Buerger (1986) indicated that the albus variety Hamburg was tested with recommended rates of diflufenican in Victoria but no indication was given as to its sensitivity. Addition of simazine to diflufenican is commonly practiced by farmers in Western Australia to enhance control of wild radish (*Raphanus raphanistrum*) and doublegee. This combination was consistently damaging in the trials and always reduced yields below that of the standard simazine treatment. Given that simazine is nearly always used pre-seeding for lupins in Western Australia it is not surprising that diflufenican will damage the crop as the two herbicides are likely to be present in the plant at the same time given the timings at which diflufenican is applied.

Diflufenican in mixture with metribuzin was also very damaging to the crop and is a reflection of the poor tolerance of albus lupins to either diflufenican or metribuzin. Metribuzin applied pre-emergence to the crop was clearly safer than when applied post-emergence. Sorlino *et al.*

(1993) indicated that metribuzin was the safest of a range of pre-emergence herbicides tested on albus lupins in Argentina, whereas Adamczewski and Paszkiewicz (1988) found much poorer tolerance to metribuzin than to other triazine herbicides.

The new herbicide metosulam was one of the safest post-emergent herbicides for use in albus lupin. With the exception of the Ellendale Pool site, crop and yield effects were small. The possible interaction with zinc deficiency at Ellendale Pool will require further research as the yield penalties from such an interaction were highly signifiacant. Mixtures of diflufenican with metosulam also appeared to have better crop safety, an observation which has also been made on *Lupinus angustifolius*.

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