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Development of herbicide tolerant lupin varieties.

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DEVELOPMENT OF HERBICIDE TOLERANCE LUPIN VARIETIES

1990 EXPERIMENTAL SUMMARY

J COOPER

Using atrazine post emergence:

90GL26

Response of lupin varieties to metribuzin applied post emergence

90GL28

90GL32

90GL35

90GL36

Screening new lines with metribuzin

Selection of new lines in field

90WH85

90WH86

Title: Effect of growth stage at application of response to atrazine

Trial Number: 90GL26

Introduction:

To determine the optimum stage for application of atrazine to show the most consistent and maximum differences between varieties of lupins in glasshouse tolerance trials.

Previous glasshouse trials have attributed poor plant responses to atrazine application at the wrong stage (ie 8 leaf stage instead of 3-4 leaf stage). The response of younger plants to atrazine application may be greater due to either greater uptake by the taproots, or greater uptake by laterals when they grow through soil that has atrazine present.

Design of Trial:

Varieties: Danja and Gungurru

Rates: 0, 0.1, 0.2, 0.3, 0.4 & 0.8 ppm Atrazine

Environment: Washed river sand in 1 Kg pots

15/18°C air conditioned glasshouse

4 seeds per pot thinned to 2 healthy seedlings

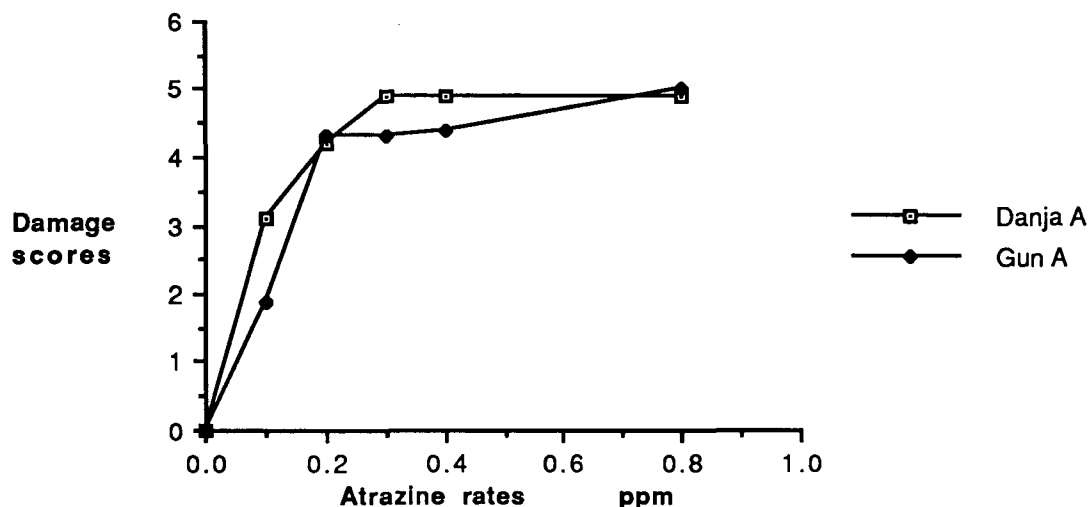
Herbicide applied at 2 leaf or 3-4 leaf stages

RESULTS

All seedlings treated at the 2 leaf stage died within 7 days.

The only difference between the responses of Danja and Gungurru occurred at 0.1ppm and they were not significantly different. At greater rates all the plants were dead or severely wilted by 10 days.

Response curve from damage scores at 10 days after application



CONCLUSIONS

* To use plants at a younger growth stage the rate of application would have to be adjusted as they are more sensitive to damage. It is simpler to wait until seedlings are slightly older and within the response curve we have produced.

* The rate that shows the greatest difference in response between Danja and Gungurru is 0.1 ppm. There is not a large enough difference to use for screening. There is poor repeatability of previous results.

Title: Response of lupin varieties to metribuzin applied post emergence.

Trial Number: 90GL28

Introduction:

This is an initial quick screening to determine if the same pattern of responses occurs when metribuzin is applied as when simazine/atrazine is used. Field rates were used assuming that there are 1,250,000 pots/ha. The recommended rate applied to peas is 300g/ha so this was used as an estimate of the amount needed for weed control.

Design of Trial

Varieties: Danja, Gungurru

Rates: 0, 100, 200, 300, 400 & 800 g/ha metribuzin

Environment: Washed river sand in 1 Kg pots.

15/18°C air conditioned glasshouse

Planted 4 /pot thinned to 2.

Herbicide applied as 10ml aqueous solution onto soil surface at 3-4 leaf stage.

RESULTS

Damage Scores

RATES	8 days		9 days		14 days	
	Gungurru	Danja	Gungurru	Danja	Gungurru	Danja
0	0	0	0	0	0	0
100	1	2.2	1.1	3.5	1.8	4.8
200	3.1	2.6	4.0	3.8	4.2	5
300	3.2	4.1	3.9	4.9	5	5
400	4.2	3.9	5	5	5	5
800	4.5	4.6	5	5	5	5
LSD			0.56			

Scale: 0 no effect
5 collapse and death

CONCLUSIONS:

* The difference in responses to metribuzin between Danja and Gunguru was the same as that shown to other triazines.

* Response curves for Gungurru and Danja both need more points below 200g/ha. This will be the next experiment in this series.

* Since the amount of herbicide required in glasshouse trials to cause damage is 2-3 times smaller than that required in the field then 200-300g should be tolerated by Gungurru in the field. This rate was been added to the lupin tolerance trials at East Beverley and East Chapman.

Title: Response of lupin varieties to metribuzin applied post emergence.II

Trial Number: 90GL32

Introduction:

The first metribuzin tolerance trial showed that the rate at which responses differed between varieties was around 100g/ha, the lowest rate included on that curve. To form a more accurate picture of the response of lupins to metribuzin the number of rates in this region was expanded.

The same assumptions apply as in the previous experiment.

Design of Trial

Varieties: Danja, Gungurru

Rates: 0, 50, 75, 100, 125, 150 & 200 g/ha metribuzin

An atrazine treatment was also included for comparison: 0.1ppm

Environment: Washed river sand in 1 kg pots.
fertilized with aquasol twice weekly
planted 4 per pot, thinned to 2 per pot
15/18°C air conditioned glasshouse
Planted 4 /pot thinned to 2.
Herbicide applied as 10ml aqueous solution onto soil surface at
3-4 leaf stage.

RESULTS

Mean damage scores for each treatment

Rates	7 days		10 days	
	Gungurru	Danja	Gungurru	Danja
0	0	0	0	0
50	0	1.3	0	5
75	1.2	2.8	1.6	5
100	1.6	2.6	2.5	5
125	1.9	3.1	2.9	5
150	2.9	2.9	4.5	5
200	3.9	4.6	5	5
0.1ppm Atra	1.5	0.8	5	3.2
LSD	1.1			

Scale: 0 = no effect
5 = collapse and death

DRY WEIGHTS: Mean weight of two plants 14 days after herbicide application (percent control).

Rate	Gungurru	Danja
0	0.34	(100%) 0.43
50	0.37	(110%) 0.36
75	0.30	(88%)
100	0.28	(82%)
125	0.28	(82%)
150	0.23	(67%)
200	0.25	(70%)

Dead plants were not harvested once they had collapsed as they rapidly decayed. No statistical testes were carried out as all Danja treated plants died. Note that control Danja is larger than Gungurru.

CONCLUSION:

* The same pattern of response as previous experiment with Gungurru more tolerant than Danja. Danja is highly sensitive to Metribuzin so there is no future for field use on this variety but this may explain previous field results that bagged the use of metribuzin on lupins. Most field work was on older varieties such as Yandee which are more susceptible to triazines.

Title: Response of lupin varieties to metribuzin applied post emergence.III

Trial Number: 90GL35

Introduction:

The first metribuzin tolerance trials showed that the response of Danja and Gungurru to applications of metribuzin follow accepted pattern for triazine tolerance. Danja is sensitive to all the rates of metribuzin tried (lowest 50g/ha). But the limit of Gungurru's tolerance is 125g/ha with death at 150g/ha. The tolerance of other varieties has not been examined so a sample of current varieties are included here. Yorrel, Gungurru and 330 are included in field trials so a comparison of field and glasshouse responses is possible. W542 showed superior simazine tolerance in a previous pot trial and is one of Wallace Cowling's selections.

The same assumptions apply as in the previous experiments.

Design of Trial

Varieties: Gungurru, Yorrel, 75A/330, 435, 84A*17 W542
Rates: 0,75,100,125,150 g/ha metribuzin
Environment: Washed river sand in 1 Kg pots.
15/18°C air conditioned glasshouse
Planted 4 /pot thinned to 2.
Herbicide applied as 10ml aqueous solution onto soil surface at 3-4 leaf stage.

RESULTS

Damage Scores 14 days after application

Rate	Gungurru		Yorrel		75A/330		78A/435		W542	
0	0	a	0	a	0	a	0	a	0	a
75	0.4	a	1.6	b	0.5	a	0.2	a	4.6	g
100	2.0	bc	2.6	cd	2.1	bc	1.8	bc	5	g
150	3.6	ef	4.5	fg	3.5	de	3.6	ef	5	g
200	4.4	efg	4.9	g	4.4	efg	4.2	efg	5	g
LSD	0.89									

(letters show not signif diff)

Dry Matter 14 days after treatment (% control)

Rate	Gungurru		Yorrel		78A/435		75A/330	
0	0.54	(100)	0.58	(100)	0.59	(100)	0.48	(100)
75	0.43	(79.3)	0.38	(65.8)	0.45	(76.6)	0.38	(78.2)
100	0.36	(66.4)	0.29	(49.1)	0.41	(66.6)	0.28	(59.6)

Only those plants that retained most leaves were weighed so only low rates were measured. No dry matter reduction was recorded for W542 as dead plants distort weights by rotting and dropping leaves early.

CONCLUSIONS

* Still have differences between varieties. They have roughly grouped into: little damage, moderate damage and highly sensitive varieties in a pattern that matches known results for these varieties. Suggests a number of genes involved W542 was reported as having superior simazine tolerance in a previous experiment but has performed worst of the five varieties examined.

* The dry matter reduction appears before any sign of damage in these varieties. This segregates roughly into two groups with Yorrel depressed most.

Title: Response of lupin varieties to metribuzin applied post emergence.IV

Trial Number: 90GL36

Introduction: This is a repeat of the previous trial which investigated the response of five varieties to metribuzin. The purpose is to confirm repeatability of using metribuzin in glasshouse for screening breeding lines of lupins. Illyarrie is one of the parents of current varieties so needs checking.

The same assumptions apply as in the previous experiments.

Design of Trial

Varieties: Gungurru, Yorrel, 75A/330, 78A/435, Illyarrie

Rates: 0,75,100,125,150 g/ha metribuzin

Environment: Washed river sand in 1 Kg pots.

15/18°C air conditioned glasshouse

Planted 4 /pot thinned to 2.

Herbicide applied as 10ml aqueous solution onto soil surface at 3-4 leaf stage.

RESULTS

Damage Scores at day 14

Rate	Gungurru		Yorrel		75A/330		78A/435		Illyarrie	
0	0	a	0	a	0	a	0	a	0	a
75	1.5	bcd	2.8	ef	0.1	a	0.6	ab	3.4	fgh
100	2.0	cde	3.5	fgh	1.2	bc	2.2	de	2.1	cde
150	3.7	ghi	4.8	j	3.8	ghi	4.4	hij	4.2	hij
200	4.4	hij	4.5	ij	4.1	hij	4.5	ij	4.8	j

LSD 0.97

(letters show not sig diff)

Dry Matter 14 days after treatment (% control)

Rate	Gungurru		Yorrel		78A/435		75A/330		Illyarrie	
0	0.44	(100)	0.53	(100)	0.54	(100)	0.38	(100)	0.58	(100)
75	0.34	(78.8)	0.36	(68.9)	0.47	(87.1)	0.37	(96.1)	0.34	(59.3)
100	0.30	(67.8)	0.31	(59.)	0.36	(65.4)	0.36	(93.5)	0.34	(58.4)
150	0.28	(62.7)	0.23	(44)	0.27	(47)	0.26	(67.5)	0.27	(46.4)
200	0.27	(61.6)								

The regression lines fitted to each response curve are:

Gungurru = $94 - 0.20x$ (SE 0.04)

75A/330 = $104 - 0.20x$ (SE 0.09)

78A/435 = $104 - 0.36x$ (SE 0.08)

Illyarrie = $95 - 0.36x$ (SE 0.07)

Yorrel = $98 - 0.38x$ (SE 0.02)

CONCLUSIONS

* There is the same pattern as in the previous trial but the absolute values are not identical. All screenings will require both Danja and Gungurru as standards to reference against.

* The dry matter reduction appears before any sign of damage in these varieties. The varieties segregate into two groups with similar slopes for their response curves. This suggests a small number of genes are involved or that the same combination of genes are present in both Gungurru and 75A/330.

ALTERNATIVE TESTING METHODS

The use of metribuzin as the screening agent for triazine tolerance has been confirmed. Application of atrazine post emergent has proved too unreliable to allow screening of new varieties. Simazine incorporation in soil was also ineffective and time consuming..

Several experiments attempting to grow lupins in root cooling tanks which are available for greater portion of the year were abandoned because of contamination of the soil plastic stabilizers leaching from the cups used.

Techniques for glasshouse screening for Ally®, Diuron and Bromoxynil tolerance are a preliminary stages.

Title: Screening new lines with metribuzin

Introduction:

Two experiments have been completed to screen lupin lines selected at WHRS in 1989. The lines investigated were selected from the best 50 plants treated with the high rate of simazine application (16L/ha) at WHRS in 1989 that had acceptable seed production when bulked at Manjimup. They were compared to Gungurru and Danja as standards. The lines selected may have missed application through a blocked jet so may simply be the better plants growing with less competition from neighbours. They may be the result of selection within variation in Gungurru rather than an induced mutation.

Design of Trial 1

Varieties: Danja, Gungurru and 11 new lines detailed below
Rates: 0,75,100 g/ha metribuzin
Environment: Washed river sand in 1 Kg pots.
15/18°C air conditioned glasshouse
Planted 4 /pot, thinned to 2.
Herbicide applied as 10ml aqueous solution onto soil surface at 3-4 leaf stage.

RESULTS

Dry matter production as percent control and damage scores ()

Line	75g/ha		100g/ha	
Gungurru	115	(0)	100	(0.6)
Danja	47.9	(5)	36.9	(5.0)
89J18	96.7	(0)	91.5	(0)
89J55	85.4	(0)	64.1	(1.5)
89J29	84.5	(0.3)	63.5	(0.5)
89J16	92.0	(0)	74.9	(0.5)
89J13	101	(0)	71.2	(0.6)
89J15	98.7	(0)	71.2	(0.3)
89J25	86.5	(0)	75.8	(0.5)
89J1	91.3	(0)	70.1	(0.5)
89J3	88.2	(0.3)	72.1	(1.3)
89J23	85.1	(0)	70.2	(0.3)
89J28	81.9	(0)	69.6	(1.0)

Only line 89J18 is equal to Gungurru at 100g/ha rate and no line shows superior tolerance at these rates. Visual damage scores were small for this trial, possibly due to excessive weekend watering removing metribuzin from system. However dry matter reduction still occurred in most lines.

Design of Trial 2

Varieties: Danja, Gunguru and 11 lines
Rates: 0, 100, 150 g/ha metribuzin
Environment: Washed river sand in 1 Kg pots.
15/18°C air conditioned glasshouse
Planted 4 /pot, thinned to 2.
Herbicide applied as 10ml aqueous solution onto soil surface at
3-4 leaf stage.

RESULTS

Dry matter production as percent control and damage scores () 14 days after metribuzin application.

	100g/ha		150g/ha	
Gungurru	49.3	(3.8)	42	(4.5)
Danja	43.6	(5.0)	40.1	(5.0)
89J4	46.7	(3.1)	37.7	(4.0)
89J14	52.4	(3.0)	38.5	(4.4)
89J56	64.8	(2.0)	46.0	(4.5)
89J10	53.2	(2.1)	41.4	(3.5)
89J40	48.6	(2.7)	42.4	(5.0)
89J36	50.9	(3.5)	46.8	(4.5)
89J20	67.2	(1.9)	45.2	(4.0)
89J6	60.1	(2.0)	45.2	(4.3)
89J8	49.4	(3.0)	41.8	(4.6)
89J51	49.1	(3.1)	41.2	(4.0)
89J19	43.6	(3.0)	48	(4.6)

The lines that were superior to Gungurru were J56, J20 and J6. The increase will need to be further tested before inclusion in new varieties. Some of the other lines were equivalent to Gungurru, which was their parent line, implying that selection of these plants was not selecting a mutant but better plants within Gungurru population.

Lines J19 and J4 had problems of root disease in pots which may be a sign of mutation effect. This may have been a symptom of mutations however Gungurru has previously shown these problems in pot trials.

Title: Selection for herbicide tolerance from a mutated lupin population

Trial Number: 90WH85

Aim: To select from a mutated population for enhanced tolerance to a range of herbicides that have potential for controlling doublegees post emergence in lupin crops.

Officers: J. Cooper, R. Klemm, J. Ferguson

Location: Wongan Hills Research Station

Environment: Loamy sand.following a wheat crop

Treatments:

Simazine	8 l/ha
Simazine	16 l/ha
Ally®	5 g/ha
Bromoxynil	2 l/ha
Diuron	2 l/ha
Pursuit®	800 ml/ha

Method: Simazine applied to all plots 2 l/ha.

17th May Simazine treatments applied IBS along plots (10 x 50m) as multiples of 2 l/ha.

17th May The total area was bulk seeded across plots. 100 Kg/ha superphosphate drilled with seed.

7th June Post emergence herbicides applied to plots; Ally® (40m x 50m), Bromoxynil (40 x 50m), Diuron (25m x 50m), Pursuit (25m x 50m)

Harvest: No plants from the simazine treatment were harvested as they showed no signs of damage at either rate.

The Pursuit treatment caused stunting but there were no outstanding plants. This was bulk harvested and will be used as base population in 1991.

Grab samples from the best plants in the Ally, Bromoxynil and Diuron treatments were taken. It is suspected that the period of frosty, dry weather after application of post emergent herbicides reduced uptake and so lessened the degree of damage suffered. These will be further examined in the glasshouse.

Title: Production of a mutated lupin population

Trial Number: 90WH86

10 kg of Gungurru lupin seed was mutated by treatment with sodium azide.

This was sown by hand broadcasting onto prepared soil and incorporated with trailing harrows. No selection was carried out in this generation. The grassweeds were controlled with Fusilade with no simazine treatment pre sowing.

The seed was bulk harvested and will be selected from in 1991 in a program similar to 90WH85.