Physical and chemical weed control in wide row lupins

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Key messages

Cultivation between the crop rows cannot provide full weed control because the weeds within the rows are not killed.

Cultivation (sweeps at sowing and in crop cultivation) combined with metribuzin sprayed onto the crop row at seeding gave 100% control of wild radish. Although unregistered for post sowing pre emergent application, metribuzin over the row also gave reduced ryegrass seed set in wide row lupins at Merredin.

Shielded spraying may be worth another look as it did reduce weed seed numbers without a great yield penalty.

Aims

Cultivation between crop rows is a common tool for weed suppression in Europe, which is not utilised in Western Australia. Inter-row cultivation can be used within wide row crops (i.e. lupins), in order to disturb weed growth between crop rows while causing minimal damage to the crop plants. The degree of damage this technique causes to the weeds is influenced by weed species, soil moisture levels and the probability of post-cultivation rain. This method may cause damage to the lupin crop, which will be influenced by speed of cultivation, degree of soil throw, stage of crop development and crop density. It may prove to be an effective method of controlling herbicide-resistant wild radish in lupin crops, which is increasingly difficult to achieve with herbicides.

Banded over the row herbicides may help reduce the common problem of in-row weeds. Coromup lupins are the most tolerant of metribuzin so an over the row pre-emergent application will be tested although is not registered. Organic growers in other countries have used sweeps to scrape away the surface soil near the row to reduce in-row weeds.

Research is required to determine the success of cultivation or harrowing within young crops in WA, in terms of weed control and crop damage. If successful, these techniques are likely to be useful to both organic and conventional growers.

The aim of the study was to examine if weed growth and seed set can be suppressed by mechanical methods and to assess the effect of over-the-row surface soil removal and banded herbicides on weed numbers and lupin crop damage.

Method

Treatments

1. Untreated control.
2. Cultivate between rows 3 weeks after sowing + again after 3 weeks + again after 3 weeks.
3. Treatment 2 plus 1000 g/ha in 22 cm band of simazine900 over the row after sowing.
4. Treatment 2 plus 2000 g/ha in 22 cm band of simazine900 over the row after sowing.
5. Treatment 2 plus 3000 g/ha in 22 cm band of simazine900 over the row after sowing.

6. Treatment 2 plus 200 g/ha in 22 cm band of metribuzin750 over the row after sowing.
7. Treatment 2 plus 400 g/ha in 22 cm band of metribuzin750 over the row after sowing.
8. Treatment 2 plus 600 g/ha in 22 cm band of metribuzin750 over the row after sowing.
9. Sweeps to remove surface soil at sowing + cultivate between; 3 weeks after sowing, + 3 weeks, + 3 weeks.
10. Treatment 9 plus 400 g/ha metribuzin750 in a 22 cm band over the row after sowing.
11. 400 g/ha of metribuzin750 in 22 cm band over the row after sowing plus inter-row spray shield applying Spray.Seed® at 3.0 L/ha at first lupin budding
12. 400 g/ha metribuzin750 over-the-row after sowing then post emergent Select® 1000 mL/ha (3 leaf ryegrass) and 10 days later 100 mL/ha Brodal Options® + 150 mL/ha metribuzin750.

Experiment details

The experiment was a randomized block design with 3 reps and analysis by Genstat 15.

Sown: 9 May 2013, 5 rows with the row spacing combine at 66 cm row spacing.

Seed: 90 kg/ha lupins cv. Coromup + Rovral® (seed wt 139 g/1000).

Fertiliser: 37.5 kg/ha Big Phos® (6.5 kg/ha P, 6.0 Ca, 1.3 S) banded 2 cm below the seed.

Points: 40 mm Primary Sales Australia cast, cut down 3" steel that were 2 cm shallower than the fertiliser points. Treatment 9 had 10" Agpoint No. 16310 sweeps with a fabricated soil remover plate behind to push topsoil and weeds seeds sideways before the fertiliser and seed tines (Photo 1).

Press wheels: Janke 110mm wide set at 2 kg/cm width with 150 mm ID 16 mm ring harrow

Tractor: JD 4240 (4.0 km/h) for seeding using FM1000 autosteer.

Sprays: 9 May 2.0 L/ha Roundup Attack, Mentor® WG metribuzin on the press wheels. Teejet AI95015EVS nozzles at 2.1 bar pressure gave 505 mL/min of coarse spray quality in a 20 cm wide band. The ring harrow followed the spray nozzle (photo 2).

21 June 1.0 L/ha Select® on treatment 12, day temp 16°C.

2 July 100 mL/ha Brodal® + 150g/ha metribuzin750 on treatment 12, .

Cultivation: 5 June Treatments 2-10: 5.6 km/h, two 250 mm wide sweeps between the rows (Photo 2).

20 June Treatments 2-10: 7.3 km/h, two 250 mm wide sweeps between the rows

18 July Treatments 2-10: 7.7 km/h, two 250 mm wide sweeps between the rows

20 Aug the 44 cm wide shielded sprayer with DG95015EVS nozzles at 2 bar (500 mL/min) at 4.6 km/h delivering 3.0 L/ha Spray.Seed® with 150 L/ha water.

14 Aug an attempt was made in a buffer for one more cultivation using a rotary hoe to lift out transplants but the lupins branches were being run down so was abandoned.

Measurements: Lupin density was assessed in two quadrats (0.66 by 0.66 m) per plot and visual assessment was used to assess lupin growth, using a scale of 1 (poor growth) to 10 (good growth). Weed density was assessed in two quadrats (0.33 by 0.66 m) per plot and visual assessment was used to assess weeds on the crop rows and between the rows, using a scale of 1 (low density) to 10 (high density). Weeds included wild radish, annual ryegrass and white oats, all of which were assessed separately. The wild radish plant number had a square root transformation to normalise the variance.

Harvest: 27 Nov by Matt Harrod with a KEW plot header and the centre 3 rows per plot were harvested.

Results

The lupin density was fairly even and around the target density of 40 plants/m^2 (table 1).

Photo 1 Leading sweeps and soil remover plate

Photo 2 Banding spray nozzle following the press wheel and before the ring harrow (left) and two sweep points between each row for inter-row cultivation (right).

Table 1 Lupin density and lupin and in-row weed assessment.

Treat	Treatment	Lupins 13 June (pl/m^2)	In-row weed rating 30 July (1 low - 10 high scale)	Lupin growth rating 30 July (1 low - 10 high scale)
1	Nil	37.1	9.2 ab	7.0 b
2	Cultivate	36.7	9.0 abc	9.0 a
3	Treat 2 + 1000g sim	36.3	7.7 bcde	8.7 a
4	Treat 2 + 2000g sim	33.7	8.2 abcd	8.5 a
5	Treat 2 + 3000g sim	36.7	8.5 abcd	8.3 a
6	Treat 2 + 200g met	38.6	8.0 abcd	8.3 a
7	Treat 2 + 400g met	42.1	8.2 abcd	9.0 a
8	Treat 2 + 600g met	42.5	7.0 de	8.3 a
9	Treat 2 + sweeps	37.1	7.5 cde	8.8 a
10	Treat 9 + 400g met	31.0	6.0 e	8.7 a
11	Shielded sprayer	40.6	9.3 a	6.7 b
12	Select + Brodal	44.4	9.2 ab	7.2 b
	Average	38.1	8.1	8.2
	Lsd	n.s.	1.76	0.887
	p value	0.068	0.020	<0.001
	C. of V%	12.0	12.8	6.4

The sweeps with 400g of metribuzin appeared to have lower weed growth than most other treatments (table 1). The lupin growth was similarly assessed and the treatments of nil, shielded sprayer (which hadn't been used at the time the visual assessment was performed) and Select + Brodal appeared to be less effective than the other treatments.

The ryegrass head density was variable but high on the Select + Brodal treatment so either they were resistant or were very stressed at spraying time. Most other treatments reduced the ryegrass head number by around one quarter (table 2). Sweeps plus 400 g/ha metribuzin gave complete wild radish control. There were some white oats in the experiment and Select + Brodal reduced their number to zero.

Table 2 Annual ryegrass head density, wild radish and white oat plant density and lupin yield following each treatment.

Treat	Treatment	Ryegrass head density 7 Nov ** (heads/m^2)	Wild radish plant density** 7 Nov * (sqrt plants/plot)	White Oat Density 7 Nov (heads/m^2)	Lupin yield 27 Nov** (t/ha)
1	Nil	405 a	2.97 (8.82) de	14.8	1.40 e
2	Cultivate	121 cd	2.68 (7.18) de	2.6	1.72 d
3	Treat 2 + 1000g sim	113 cde	3.20 (10.20) e	1.0	1.88 abc
4	Treat 2 + 2000g sim	125 cd	1.75 (3.06) bcde	1.0	1.81 cd
5	Treat 2 + 3000g sim	108 cde	2.20 (4.84) cde	1.0	1.68 d
6	Treat 2 + 200g met	137 c	1.41 (1.99) abcd	8.2	1.88 abc
7	Treat 2 + 400g met	103 cde	2.06 (4.24) bcde	1.5	1.97 a
8	Treat 2 + 600g met	82 cde	0.58 (0.34) ab	3.6	1.97 a
9	Treat 2 + sweeps	104 cde	2.10 (4.41) bcde	6.1	1.81 bcd
10	Treat 9 + 400g met	57 e	0.00 (0.00) a	6.1	1.96 ab
11	Shielded sprayer	66 de	0.80 (0.64) abc	4.1	1.70 d
12	Select + Brodal	265 b	2.05 (4.20) bcde	0.0	1.70 d
	Average	140	1.82 (3.31)	4.2	1.79
	Lsd	64.7	1.59	n.s.	0.157
	p value	<0.001	0.010	0.119	<0.001
	C. of V%	27.2	51.7	130.6	5.2

* back transformed squared in brackets, ** similar letters after are not significantly different ($p<0.05$)

The lupin yield was surprisingly good for the season with the best at 1.97 t/ha (table 2). The 1 L/ha rate of simazine was higher yielding than the 3 L/ha so maybe 3 L/ha caused simazine damage. There was no significant difference between all treatments with metribuzin applied. Interestingly the shielded sprayer gave 1.7 t/ha with low weed number. The sweeps alone appeared no better yielding than treatments only using cultivation. However, with metribuzin added, the yield was better than only cultivated treatments.

Conclusion

Although unregistered for post sowing pre emergent application, metribuzin over the row gave reduced weed numbers and still gave relatively high yield with Coromup lupins.

Shielded spraying may be worth another look as it did reduce weed seed numbers without a great yield penalty. Earlier application of Spray.Seed® in the shields may have reduced weed growth and therefore resulted in more soil water for crop growth and greater crop yields.

Key words

Lupins, ryegrass, wild radish, seed set, inter-row cultivation, physical weed control

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