Herbicide tolerance of PBA Barlock – a new Narrow Leafed Lupin variety

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Key messages

- PBA Barlock tolerated a range of commonly used lupin herbicides and herbicide mixtures at the recommended rates.
- PBA Barlock possesses metribuzin tolerance similar to Mandelup and Coromup.
- PBA Barlock seems sensitive to label rates of Eclipse® and Brodal® + Eclipse®. This variety also registered low crop safety margin for diuron 2 L/ha.

Aims

PBA Barlock is a new high yielding, early maturing, anthracnose and pod shattering resistant variety of narrow leafed lupin, released during 2013. It is suitable as a replacement variety for Tanjil and Wonga in most lupin growing areas of WA.

Three trials under weed free conditions were conducted to identify herbicide sensitivities of PBA Barlock with the view to reduce its yield losses due to herbicide damage. Mandelup during 2011 and Corromup during 2012 and 2013 were included as standard varieties for comparison.

Method: Table 1

Trial Years	2011	2012	2013
Location	Northern Sandplain Research Annex, Eradu.		
Soil Type	Loamy sand	Loamy Sand	Loamy Sand
Soil pH ($CaCl_2$) and OC (%) in the top 0-10 cm of soil layer	6.2 and 0.68	6.2 and 0.68	5.9 and 0.47
Trial design	Criss-cross, every 5th plot as untreated control.		
Varieties	PBA Barlock, Mandelup and Coromup.		
Net plot size and replications	10 - 19 m X 1.1 m (5 rows at 22 cm row spacing) and 3 replications. To convert plot yield to kg/ha, 1.8 m plot width used (plot centre to centre).		
Seeding date Seeding rate	19 May 100 kg/ha	8 June 100 Kg/ha	16 May 100 kg
Seed treatment before sowing	Rovral® 100 mL and Thiroflo® 150 mL/100 kg seed.		
Seeding machinery and sowing depth	Coneseeder with knife points and press-wheels and 3-5 cm deep.		
Fertilizer at seeding (Bigphos = P:S:Ca:13.5:7.5:18%)	Bigphos 100 kg/ha	Super Mn 100 kg/ha	Bigphos + Mn 100 kg/ha
Rhizobium inoculation at seeding	ALOSCA® group S granular inoculant 10 kg/ha applied with seed.		
Gravimetric soil moisture at crop seeding, at a depth of 0-10 cm: and 10-20 cm: Rainfall within 4 weeks of seeding:	 2.3 % 2.3 % 80.8 mm	 2.4 % 2.3 % 120.6 mm	 3.7 % 4.1% 30.6 mm

Herbicide application machinery:	Spray rig with shields on boom at a width of 1.5 m. Air induction nozzles (AIXR11002) and 80 L/ha water volume used.		
Herbicides application date: Before seeding, 2, 4 and 8 leaves	19/5, 7/6, 7/6 and 22/6	3/6, 22/6, 28/6 and 12/7	16/5, 31/5, 7/6 and 21/6.
Visual observation scale:	0 to 100%, where 0% = no visual injury and 100% = complete plant death. Plants observed visually 2-3 weeks after each treatment application and at flowering.		
Blanket sprays:	Select® 0.5L/ha on 15/6/11, 3/7/12 and 13/6/13.		
Harvesting date	11 November	31 October	6 November

Rainfall (mm) : May – October	May	June	July	Aug	Sept	Oct	Total
2011	65.0	56.0	76.8	89.6	40.6	72.8	400.8
2012	7.0	129	17	42	43	5.8	243
2013	78.6	2.8	50.8	89.6	59	19.8	300.6

In the above Table 1, the figures of rainfall within 4 weeks of seeding include

- 2011: A single rainfall event of 81 mm, 10 days after seeding.
- 2012: 53 mm 2 days after seeding, then another 12 and 15 mm within the next 5 days.
- 2013: Only 31 mm of rainfall was recorded within 4 weeks after sowing. The highest rainfall events of this period were 10 and 11 mm recorded on the 5 and 6 days after seeding.

The average rainfall from May to October at Eradu over the last 10 years (2004-2013) was 285.2 mm. During 2011 and 2013, the rainfall was 41% and 5% higher than the May-October average, respectively. However, during 2012 it was 15% lower than the 10 years average rainfall. During 2012, June was wet compared to a very dry June in 2013.

Higher than label rates of the herbicides were included in the trials to determine the crop safety margin of the herbicides at the maximum label rates. **Good crop safety margin** means that a herbicide at its maximum label rate and at the higher rate was tolerated well by a crop variety. Where as, **low crop safety margin** for a particular herbicide indicates that the variety tolerated the maximum label rate well, but at higher than the label rate there was significant yield loss. A Low crop safety margin implies that when spraying under less than optimal conditions, herbicide damage and yield loss may occur. For example, when:

- Overlapping herbicide
- Spraying under wet conditions (for soil active and residual herbicides)
- There are stressed plants due to abiotic/biotic factors.

Results and discussion

The effect of herbicides during early crop growth stages, at flowering and on grain yield (Table 2) of lupin varieties was as follows:

- The pre-emergent herbicides simazine, diuron, Outlook® and Terbyne® at the label rates were tolerated well by all the varieties except that simazine 2 L/ha caused significant yield loss (4.7%) in PBA Barlock during 2011.
- The pre-emergent herbicides at higher than the label rates caused visual necrosis (10-15%) across all the varieties and diuron also suppressed biomass of all the varieties by around 15

% (observed at flowering stage) during 2012. As a result, diuron at the higher rate resulted in significant yield loss in PBA Barlock during all three years of testing, whereas significant yield loss in Mandelup and Coromup was recorded during 2011 and 2012, respectively. Simazine at the higher rate caused significant yield loss in Mandelup and PBA Barlock during 2011 and only in Caromup during 2012. Outlook® at the higher than label rate reduced grain yield only of Coromup significantly during 2012.

- Heavy rainfall events within 2 weeks of trials' seeding especially during 2011 and 2012 might have contributed in significant yield loss in lupin varieties from these soil active and/or residual pre-emergent herbicides. The heavy rainfall events might have washed the herbicide treated soil in the seeding furrows and thus increasing herbicide concentration in the furrows. The differential response of the lupin varieties to these pre-em herbicides could be due to differences in the herbicidal prosperities like water solubility, leaching and adsorption on to soil particles. For example diuron has 7 and 4.5 times higher water solubility than simazine and Terbyne, respectively (*HerbiGuide 2013)*.
- The post-emergent herbicides like Brodal® and Eclipse® either alone or in mixture with other herbicides caused visual chlorosis and yellowing, and metribuzin and simazine resulted in necrosis. With the increase in herbicide or herbicide mixture rates, the intensity of these symptoms also increased. Most of these symptoms were out grown by the time crop reached the flowering stage.
- Lexone® (metribuzin) alone or in mixture with Brodal® at the maximum label rates was tolerated well by all the varieties across all the trials. However, Lexone® at the higher rate caused significant yield loss in Mandelup and PBA Barlock during 2011. Brodal® + Lexone® at the higher rate caused significant yield loss only in PBA Barlock during 2013.
- Brodal® + simazine at 100 mL + 0.5 L/ha and the higher rate of this mixture applied at 4 leaf stage was tolerated well all the varieties across all the trials.
- Eclipse® at 7 g/ha alone and in mixture with Brodal® at 100 mL/ha and their higher rates resulted in significant yield loss in PBA Barlock during 2011 and 2013. However, grain yield of the standard varieties was affected significantly with the higher rate of Eclipse only during 2011 and 2013.

Conclusions

- PBA Barlock tolerated simazine, diuron, Outlook®, Terbyne®, Brodal®, metribuzin, Brodal® + metribuzin, Brodal® + simazine at the label rates quite well.
- PBA Barlock seems to have metribuzin tolerance similar to Mandelup and Coromup.
- PBA Barlock registered low crop safety margin for diuron 2 L/ha during all three years of testing and for simazine 2 L/ha during 2011 only. The standard varieties were affected by these rates of diuron and simazine during both 2011 and 2012.
- PBA Barlock seems sensitive to Eclipse® and Eclipse® + Brodal® and this tolerance is lower than Mandelup and Coromup especially for Eclipse + Brodal®.
- The interaction of pre-emergent herbicide characteristics with heavy rainfall after crop seeding could cause crop damage, if the herbicides washed into the crop root zone.

References

HerbiGuide (2013) Herbicide and Pesticide information for crops, pastures, vegetables and orchards. http://www.herbiguide.com.au

Note: Always follow label recommendations. The Department of Agriculture and Food WA, does not endorse the use of herbicides above the registered rate or off-label use of herbicides or off-label tank mixes. Crop tolerance and yield responses to herbicides are strongly influenced by seasonal conditions.

Key words

Narrow leafed lupin, herbicides, tolerance and grain yield.

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Table 1: Effect of herbicides on grain yield (% of untreated control) of narrow leafed lupin varieties at Eradu (2011-13).

Herbicides (Rate/ha)	Timing	Mandelup	PBA Barlock			Coromup	
Years		2011	2011	2012	2013	2012	2013
Grain yield of untreated Control (kg/ha)		3020	3859	1751	3270	1731	2827
Simazine 2 L (*)	Pre-seeding	94.4	**95.3**	103.6	98.2	100.4	100
Simazine Higher rate	"	**93.5**	**93.2**	94.3	92.4	**90.7**	93
Diuron 2 L	"	107.1	97.6	102.7	96.9	99.0	93
Diuron Higher rate	"	**90.6**	**82.5**	**86.8**	**88.3**	**81.6**	97
Outlook 1.0 L *(Dimethenamid-P)*	"	–	–	107.8	102.3	102.3	102
Outlook Higher rate	"	–	–	97.7	96.6	**92.8**	92
Terbyne® 1.4 Kg *(Terbuthylazine)*	"	99.8	97.7	–	–	–	–
Terbyne® Higher rate	"	100.6	95.7	–	–	–	–
(*)Brodal® 200 mL *(Diflufenican)*	2 leaves	99.7	95.9	101.7	94.7	102.8	95
(*)Brodal® Higher rate	"	96.0	98.9	104.0	98.3	99.6	96
(*)Lexone® 150 g *(Metribuzin)*	"	99.0	100.3	101.8	**90.3**	100.0	93
(*)Lexone® Higher rate	"	**91.8**	**95.1**	95.7	100.5	94.6	105
(*)Brodal® 100 mL + Lexone® 150 g	4 Leaves	99.0	100.3	106.4	98.9	110.8	100
(*)Brodal® + Lexone® Higher rate	"	97.2	96.7	94.2	**88.1**	93.8	93
(*)Brodal® 100 mL + Simazine 0.5 L	"	99.8	96.6	102.7	96.4	108.5	98
(*)Brodal® + Simazine Higher rate	"	98.8	98.9	97.4	94.8	99.8	100
(*)Eclipse® 7 g *(Metosulam)*	8 Leaves	101.6	96.8	99.4	**89.6**	99.9	**88**
(*)Eclipse® Higher rate	"	99.9	**89.0**	98.5	**79.3**	98.4	**82**
Eclipse® 7 g *(Metosulam)*	"	98.4	94.8	–	–	–	–
Eclipse® Higher rate	"	**94.0**	**95.4**	–	–	–	–
(*)Brodal® 100 mL + Eclipse® 7 g	"	95.1	**94.1**	101.6	**85.7**	99.4	93
(*)Brodal® + Eclipse® Higher rate	"	97.1	**92.3**	102.9	**87.4**	98.2	92
Lsd (0.05) Control vs Herbicides (1-tail)		5.8	4.5	6.4	7.7	7.0	9.6
Lsd (0.05) Herbicides vs Herbicides (1-tail)		7.6	5.9	8.3	10.0	9.2	12.6
CV (%)		5.6	4.4	6.2	7.5	6.9	9.3

(*) indicates simazine 2.0L/ha as a basal treatment. − = Not tested. The names in the parenthesis are the herbicide chemical names.
Figures in **BOLD** are significantly lower than untreated control. Simazine 500 2L = Simazine 900 1.1 kg and Diuron 500 1L = Diuron 900 556 g.