L10 Herbicide Tolerance, MRZ Wimmera (Rupanyup), Victoria

Aim

To investigate the adaptability of a range of new herbicide tolerant lentil varieties to a range of Group B herbicides in standing and burnt stubbles.

Treatments

Stubble:	Burnt or Standing (approximately 40cm high)
Varieties:	Standing stubble - PBA HeraldXT, CIPAL1101, CIPAL1208, CIPAL1209 (all tolerant), PBA Flash (Control, Intolerant). Burnt stubble - PBA HeraldXT, CIPAL1101, CIPAL1102 (all tolerant), PBA Flash, Nipper (Controls, Intolerant).
Herbicides:	Nineteen herbicide treatments (Group B; ALS inhibitors) encompassing a range of imidazolinones, triazolopyrimides and sulfonylureas were applied at various application rates in comparison with an untreated control (Table Lxx.1).

Other Details

Sowing date:	4 May.
Row Spacings/Stubble:	30 cm row spacing, inter-row, standing stubble (ST30).
Fertiliser:	MAP + Zn @ 60 kg/ha at sowing.
Plant Density:	120 plants/m^2.
Soil Type	Alkaline Black cracking clay (pH_{H20} (0-10cm): 8.3; pH_{H20} (40-60cm): 9.0)

Results and Interpretation

➢ Key Message: . PBA HeraldXT and CIPAL1101 have s good tolerance to imidazolinone chemicals, but may not be as tolerant to Imi-3 as the lines CIPAL1208 and CIPAL1209. Conversely, PBA HeraldXT and CIPAL1101 have improved tolerance to the Sulfonylurea herbicides relative to the control and CIPAL 1208 and CIPAL 1209, indicating potential benefits where residues may be an issue in cropping systems.

- Herbicide Damage – In the *standing stubble*, visual herbicide damage symptoms were observed for all treatments applied to the intolerant genotype PBA Flash (Table 1a). Varying levels of damage were observed among the four tolerant lines. CIPAL1101 showed no significant damage symptoms from all imidazolinone herbicide treatments except 'imi-2' applied at the highest rate and imi-3 at the x2 and x4 rates. It also showed no damage from flumetsulam 800 at the x1 rate within the Triazolopyrimidine group and SU-3 within the Sulfonylurea group. PBAHeraldXT, showed similar trends, however it also showed slightly greater symptoms for imi-3 applied at all rates and recorded significant damage at the x1 rate (Table 1a). The line CIPAL1208 had no significant damage from any of the Imidazolinone, except imi-4 at the highest rate, while the line CIPAL1209 was damaged by Imi-2 at the highest rates. In addition, CIPAL1208 was significantly damaged by both rates of Flumetsulam and had significantly more symptoms than other tolerant lines, while both of the lines, CIPAL1208 and CIPAL1209, were significantly more damaged by the Sulfonylurea treatments than CIPAL1101 and PBA HeraldXT (Table 1).

  In the *burnt stubble*, symptoms were generally less in the tolerant lines than observed in the *standing stubble* (Table 1b). This may have occurred as the early growth in standing stubble was erect with more spindly plants (i.e plants were 'softer') compared with the more prostrate spreading growth observed in the burnt stubble. It was also observed that the herbicide symptoms in the standing stubble caused more leaf burning/necrosis than that on the burnt stubble. Similar to the cite at Curyo, CIPAL1101 showed no significant damage symptoms from all imidazolinone herbicide treatments except 'imi-3' applied at the highest rate. It also

showed no damage from flumetsulam 800 within the Triazolopyrimidine group and SU-3 within the Sulfonylurea group. CIPAL1102, which is a sister line to CIPAL1101 and PBA HeraldXT, showed the same trend. PBA HeraldXT was also similar however it also showed slightly greater symptoms for imi-3 applied at the x2 rate (Table 1b).

Table 1. S*tanding Stubble.* The effect of various Group B herbicide treatments on visual damage score (1 – no damage, 9 – complete plant death) recorded August 29 of the new imidazolinone lentil genotype, PBA HeraldXT in comparison with an intolerant genotype, PBA Flash and 3 new lines differing in tolerance at Rupanyup, 2012. Significant damage scores have been shaded.

Chemical[1]	**Rate**	**CIPAL1101**	**CIPAL1208**	**CIPAL1209**	**PBA Flash**	**PBA HeraldXT**
Nil		1.0	1.0	1.0	1.0	1.0
Imidazolinones						
Imazethapyr 700	100g/ha	1.0	1.0	1.0	6.7	1.0
Imazethapyr 700	200g/ha	1.0	1.0	1.0	8.0	1.0
Imazethapyr 700	400g/ha	1.3	2.0	1.3	9.0	1.0
Imi-2	x1	1.0	1.0	1.3	8.0	1.3
Imi-2	x2	1.0	1.0	1.0	8.0	1.0
Imi-2	x4	4.7	2.0	4.0	8.7	4.7
Imi-3	x1	1.3	1.3	1.0	8.3	2.3
Imi-3	x2	4.0	1.5	1.0	9.0	6.0
Imi-3	x4	7.3	1.7	1.0	9.0	7.7
Imi-4	x1	1.0	1.0	1.0	8.7	1.0
Imi-4	x2	na	na	na	na	na
Imi-4	x4	1.7	2.7	1.0	9.0	3.0
Triazolopyrimidines						
Flumetsulam 800	25g/ha	1.7	3.3	2.0	4.7	2.3
Flumetsulam 800	50g/ha	2.3	5.0	2.0	4.3	2.7
Tri-1	x1	7.0	8.3	8.0	8.3	7.0
Sulfonylureas						
SU-1	x1	8.0	9.0	8.7	9.0	7.7
SU-2	x1	3.7	9.0	8.3	9.0	5.7
SU-3	x1	2.0	6.7	4.7	7.7	1.0
SU-4	x1	8.0	9.0	9.0	9.0	8.0

1. Herbicide active ingredient or code for unregistered products. na – data not available.

Table 1.b. *Burnt Stubble.* The effect of various Group B herbicide treatments on visual damage score (1 – no damage, 9 – complete plant death) recorded August 29 of the new imidazolinone lentil genotype, PBA HeraldXT in comparison with an intolerant genotype, PBA Flash and 3 new lines differing in tolerance at Rupanyup, 2012. Significant damage scores have been shaded.

Chemical[1]	Rate	CIPAL1101	CIPAL1102	Nipper	PBA Flash	PBA HeraldXT
Nil		1.0	1.0	1.0	1.0	1.0
Imidazolinones						
Imazethapyr 700	100g/ha	1.0	1.0	7.0	6.7	1.0
Imazethapyr 700	200g/ha	1.0	1.0	7.7	7.7	2.0
Imazethapyr 700	400g/ha	1.0	1.0	8.3	8.3	1.0
Imi-2	x1	1.0	1.0	7.3	7.0	1.0
Imi-2	x2	1.0	1.0	7.3	8.0	1.0
Imi-2	x4	2.0	1.0	8.0	8.0	1.0
Imi-3	x1	1.0	1.0	8.0	8.0	1.0
Imi-3	x2	1.7	1.7	9.0	9.0	3.0
Imi-3	x4	7.0	7.3	9.0	9.0	6.7
Imi-4	x1	1.0	1.0	8.0	8.3	1.0
Imi-4	x2	na	na	na	na	na
Imi-4	x4	1.0	1.0	9.0	9.0	1.7
Triazolopyrimidines						
Flumetsulam 800	25g/ha	1.0	1.0	3.3	3.7	1.0
Flumetsulam 800	50g/ha	2.0	1.3	4.7	3.7	1.3
Tri-1	x1	6.7	7.3	8.0	8.0	7.0
Sulfonylureas						
SU-1	x1	7.0	7.3	9.0	9.0	7.3
SU-2	x1	3.7	4.0	9.0	9.0	3.3
SU-3	x1	1.0	2.0	7.3	7.0	1.0
SU-4	x1	6.7	7.3	9.0	9.0	7.0

1. Herbicide active ingredient or code for unregistered products. na – data not available.

- Biomass – Biomass data was only recorded for the standing stubble trial. Similar to visual damage symptoms biomass production varied among the genotypes that were compared in this trial (Table 2). For the intolerant genotype PBA Flash, all herbicide treatments, except Flumetsulam 800 and Imazethapyr at the x1 rate, caused significant reduction in biomass, with many treatments resulting in death. Within the tolerant lines, only minor significant reductions in yield in the imidazolinone chemical group were recorded for the x4 rate of Imi-2 and Imi-3 for PBA HeraldXT and the x4 rate of Imi-3 for CIPAL1101. Within the Sulfoylureas CIPAL1101 ahowed no significant reduction in biomass to any treatment, while PBA HeraldXT and CIPAL 1208 were unaffected by SU-3. PBA Herald was also unaffected by SU-2, while CIPAL 1209, has significant biomass reductions in all Sulfonylurea treatments (Table 2).

Table 2. *Standing Stubble* - The effect of various Group B herbicide treatments on biomass at maturity (t/ha) of the new imidazolinone lentil genotype, PBA HeraldXT in comparison with an intolerant genotype, PBA Flash and 3 new lines differing in tolerance at Rupanyup, 2012. Significant biomass reductions have been shaded.

Chemical[1]	Rate	CIPAL1101	CIPAL1208	CIPAL1209	PBA Flash	PBA HeraldXT
Nil		5.02	5.05	4.59	5.78	5.05
Imidazolinones						
Imazethapyr 700	100g/ha	7.10	5.41	6.21	4.04	3.71
Imazethapyr 700	200g/ha	6.34	6.33	5.30	1.37	5.17
Imazethapyr 700	400g/ha	6.56	4.68	5.35	0.00	5.41
Imi-2	x1	6.23	4.14	6.67	2.26	5.46
Imi-2	x2	7.36	4.54	4.68	2.15	4.17
Imi-2	x4	4.31	4.50	4.91	0.00	2.76
Imi-3	x1	5.68	5.10	6.13	0.04	3.83
Imi-3	x2	4.41	4.64	7.31	0.11	4.86
Imi-3	x4	2.78	5.01	5.66	0.00	1.14
Imi-4	x1	5.35	4.76	5.48	0.09	5.53
Imi-4	x2	na	na	na	na	na
Imi-4	x4	5.97	4.66	5.26	0.00	5.68
Triazolopyrimidines						
Flumetsulam 800	25g/ha	5.27	3.72	4.96	5.68	4.79
Flumetsulam 800	50g/ha	5.81	3.98	4.68	4.32	5.09
Tri-1	x1	4.23	0.68	2.98	0.77	4.28
Sulfonylureas						
SU-1	x1	3.52	0.00	0.78	0.68	1.07
SU-2	x1	5.37	0.58	2.65	0.17	3.86
SU-3	x1	6.39	2.68	3.92	1.96	4.95
SU-4	x1	3.46	0.00	1.01	0.00	2.37

1. Herbicide active ingredient or code for unregistered products.

- Grain Yield – Grain yields were generally higher in the plots sown on burnt stubble than the slashed stubble. This was primarily due to a significant rain event that occurred between harvest of plots on the burnt stubble compared with the standing stubble. The rain event resulted in significant lodging and pod drop on the trial in the standing stubble. Maturity on the standing stubble was up to a week later than the burnt stubble which meant that trials were not able to be harvested on the same day.
  Despite the difference in grain yields, the trends in response to herbicides was relatively similar across the stubble treatments and in comparison to the site at Curyo. For the intolerant variety, PBAFlash, all herbicide treatments, except, Flumetsulam 800 resulted in a significant grain yield loss, up to 100% for several treatments (Table x.3a). The tolerant varieties, despite showing significant crop damage in many cases, had no significant yield loss to the imidazolinone herbicides, except Imi-3 applied at the x4 rate for PBA HeraldXT and CIPAL1101 and Imi-4 applied at the x4 rate for CIPAL1209. In addition, SU-3 caused no significant yield loss in all tolerant varieties, whileSU-2 did not affect PBA HeraldXT and CIPAL1101. Conversely CIPAL1208 displayed almost complete yield loss whn SU-2 was applied.

Table 3a. *Standing Stubble:* The effect of various Group B herbicide treatments on grain yield (t/ha) of the new imidazolinone lentil genotype, PBA HeraldXT in comparison with an intolerant genotype, PBA Flash and 3 new lines differing in tolerance at Rupanyup, 2012. Significant yield losses have been shaded.

Chemical[1]	Rate	CIPAL1101	CIPAL1208	CIPAL1209	PBA Flash	PBA HeraldXT
Nil		1.98	1.48	2.04	2.08	1.43
Imidazolinones						
Imazethapyr 700	100g/ha	2.21	1.40	2.15	1.54	1.63
Imazethapyr 700	200g/ha	1.83	1.80	1.98	0.51	1.68
Imazethapyr 700	400g/ha	1.92	1.55	2.06	0.00	1.78
Imi-2	x1	2.03	1.36	2.14	0.87	1.63
Imi-2	x2	2.39	1.40	1.74	0.76	1.79
Imi-2	x4	1.98	1.40	1.68	0.03	1.35
Imi-3	x1	2.25	1.51	1.94	0.00	1.53
Imi-3	x2	2.04	1.59	2.05	0.07	1.39
Imi-3	x4	1.09	1.34	2.04	0.00	0.47
Imi-4	x1	2.08	1.32	1.84	0.00	1.72
Imi-4	x2	na	na	na	na	na
Imi-4	x4	2.05	1.18	1.56	0.00	1.57
Triazolopyrimidines						
Flumetsulam 800	25g/ha	1.92	1.41	1.81	1.70	1.75
Flumetsulam 800	50g/ha	2.23	1.19	1.86	1.61	1.62
Tri-1	x1	1.62	0.10	1.41	0.28	1.28
Sulfonylureas						
SU-1	x1	1.31	0.00	0.42	0.22	0.71
SU-2	x1	2.21	0.09	1.13	0.00	1.84
SU-3	x1	2.04	1.27	1.91	1.51	1.77
SU-4	x1	1.41	0.00	0.63	0.00	1.16

1. Herbicide active ingredient or code for unregistered products.

Table 3b. *Burnt Stubble:* The effect of various Group B herbicide treatments on grain yield (t/ha) of the new imidazolinone lentil genotype, PBA HeraldXT in comparison with an intolerant genotype, PBA Flash and 3 new lines differing in tolerance at Rupanyup, 2012. Significant yield losses have been shaded.

Chemical[1]	Rate	CIPAL1101	CIPAL1102	Nipper	PBA Flash	PBA HeraldXT
Nil		2.60	2.68	2.00	2.38	2.15
Imidazolinones						
Imazethapyr 700	100g/ha	2.31	2.36	1.62	**1.84**	1.80
Imazethapyr 700	200g/ha	2.74	2.46	**1.00**	**1.09**	2.02
Imazethapyr 700	400g/ha	2.58	2.53	**0.28**	**0.32**	2.08
Imi-2	x1	2.32	**2.00**	**1.08**	**1.39**	2.03
Imi-2	x2	2.74	**2.29**	**1.19**	**1.15**	1.78
Imi-2	x4	**2.24**	2.41	**0.25**	**0.38**	2.17
Imi-3	x1	**2.60**	2.37	**0.25**	**0.29**	2.04
Imi-3	x2	**2.50**	**2.03**	**0.00**	**0.00**	1.79
Imi-3	x4	**2.04**	**1.36**	**0.00**	**0.00**	**1.60**
Imi-4	x1	2.54	2.44	**0.24**	**0.26**	1.97
Imi-4	x2					
Imi-4	x4	2.51	2.37	0.00	0.00	2.07
Triazolopyrimidines						
Flumetsulam 800	25g/ha	2.41	2.50	1.82	2.29	2.08
Flumetsulam 800	50g/ha	2.43	2.28	1.66	2.02	1.92
Tri-1	x1	1.98	1.46	0.44	0.32	1.38
Sulfonylureas						
SU-1	x1	1.98	1.74	0.00	0.00	1.28
SU-2	x1	2.45	2.45	0.28	0.13	2.11
SU-3	x1	2.52	2.68	1.33	1.42	1.92
SU-4	x1	2.40	1.72	0.26	0.00	1.54

1. Herbicide active ingredient or code for unregistered products.

Key Findings and Comments

Similar to Curyo, this data highlights the importance of testing across a range on chemicals within a herbicide group and not assuming that tolerance will be consistent within a herbicide group. This data highlighted that PBA HeraldXT has good tolerance to imidazolinone chemicals, but may not be as tolerant to Imi-3 as the lines CIPAL1208 and CIPAL1209. Conversely, PBA HeraldXT and CIPAL1101 have improved tolerance to the Sulfonylurea herbicides relative to the controla dna CIPAL 1208 and CIPAL 1209, indicating potential benfits where residues may be an issue in cropping systems. Combining tolerances in lines like CIPAL1101 and CIPAL1209 could lead to new genotypes with tolerance to the full range imidazolinone chemicals. Pulse Breeding Australia will be utilising this information to define future breeding directions for herbicide tolerant varieties, following PBA HeraldXT.

The ongoing introduction and improvement of these herbicide tolerant lentils could result in significant farming systems benefits through improved weed control, increased control options in lentil crops and in the previous rotation phase, and decreased pressure on herbicides currently employed for broadleaf weed control in lentil. However we need to continuously monitor weed resistance levels and discuss define the optimum methods for maximising the benefits of this herbicide tolerance technology for the whole farming system.