Lentil, Herbicide Tolerance (Group B & C), MRZ Wimmera (Horsham), Victoria

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Aim
To evaluate the response of the new 'imi' tolerant variety PBA Hallmark XT and the breeding line with improved tolerance to Group C herbicides, SP1333, to novel herbicide strategies involving Group B and C herbicide products.

Treatments

Varieties:	PBA Hallmark XT, SP1333
Herbicide Treatments:	Two products were used 'imazamox & imazapyr' (Group B) and 'GpC' (Group C). They were applied at either individually, in sequence or combined at two application timings 'Post Sowing, Pre-Emergent' (PSPE) and 4 Node crop growth stage (4N). *Note: The combination treatment was applied at half rates due to a calculation error.* See Table 1 in results for details.

***Some of the herbicide treatments in this research contain unregistered herbicides, application rates and timings and were undertaken for experimental purposes only. The results within this document do not constitute a recommendation for that particular use by the author or author's organization.*

Other Site Details

	Horsham
Sowing date	14 May
Planting density (pl/m^2)	120
Stubble height (cm)	Standing (20)
Row spacing (cm)	36
Fertiliser (kg/ha)[1]	80

[1]MAP (9.2, 20.2, 0, 2.7) + Zn (2.5)

Results and Interpretation

- Key Messages: There would be significant benefit in combining improved group C herbicide tolerance with the 'imidazolinone' tolerance of varieties like PBA Hallmark XT, providing a more complete herbicide management package for lentils into the future. Results suggest that the use of Group C products at sowing in the 'imidazolinone' tolerant varieties may increase sensitivity to in crop use of 'imidazolinone' products.

- Establishment, Plant Growth and Herbicide Damage: Crop establishment was excellent, averaging 114 plants/m^2 (data not shown), due good soil moisture and rainfall following sowing. Initial crop damage symptoms from the PSPE application of herbicide treatments was slow to develop, with few symptoms noted at the 3N crop growth stage. Following application of the 4N treatments and significant rainfall during July, a high level of damage (leaf necrosis and yellowing) was observed. On July 30, PBA Hallmark XT showed significant damage from all treatments that contained GpC except the PSPE mix, where application rate was half of the individual treatments (Table 1A). In contrast the mixed treatment applied 4N caused similar damage to the 4N and PSPE GpC. The sequence of GpC applied PSPE then 'imazamox & imazapyr' at 4N caused significantly higher damage than any other treatment, suggesting that PBA Hallmark XT may have increased sensitivity to 'imazamox & imazapyr' if a Group C product has previously caused some damage. There was no significant damage from the 'imazamox & imazapyr' individual treatments, consistent with previous research. In contrast, SP1333 showed no significant damage from the GpC individual treatments, consistent with previous research showing this breeding line has improved tolerance to Group C herbicides (Table 1A). However, significant damage (chlorosis, reddening and stunting) was observed from all treatments that contained 'imazamox & imazapyr' except the PSPE mix, where application rates were half of the individual treatments. The damage from 'imazamox & imazapyr' in SP1333 was generally greater than from GpC in PBA Hallmark XT, result in

death when applied at the 4N stage. On August 29, symptoms of herbicide damage across all treatments for PBA Hallmark XT were similar to those recorded on July 30, however for SP1333 damage symptoms had increased in treatments where 'imazamox & imazapyr' was applied 4N (Table 1B).
As the season progressed, PBA Hallmark XT recovered from earlier GpC damage symptoms, so that by late October (peak biomass) no visual symptoms were observed. In contrast SP1333 did not show recovery from 'imazamox & imazapyr'. When applied at full rates at the 4N growth stage, crop death occurred.

Table 1. Visual herbicide damage scores (0 – no damage, 100 – complete plant death) from application of 'imazamox & imazapyr' and 'GpC' post sowing pre-emergent and or 4N and individually, in sequence or in combination, recorded A. July 30 (72 days after application (DOA) of the PSPE treatments 23 DOA of the 4N treatments, DOA) and B. August 29 (103 DOA PSPE & 54 DOA 4N) on PBA Hallmark XT and SP1333 at Horsham, Victoria in 2019.

A. July 30

Active ingredient (g/ha)	Application Rate (gai/ha)	Application Timing	PBA Hallmark XT	SP1333	*Ave*
Imazamox & Imazapyr	24.75 & 11.25	PSPE	3	60	*32*
Imazamox & Imazapyr	24.75 & 11.25	4N	6	73	*40*
GpC	X1	PSPE	33	3	*18*
GpC	X1	4N	27	8	*18*
Nil			0	0	*0*
GpC + Imazamox & Imazapyr	X0.5 & 5.63	PSPE	3	8	*6*
GpC + Imazamox & Imazapyr	X0.5 & 5.63	4N	33	60	*47*
Imazamox & Imazapyr then GpC	24.75 & 11.25 then x1	mox & pyr @ PSPE then GpC @ 4N	33	50	*42*
GpC then Imazamox & Imazapyr	X1 then 24.75 & 11.25	GpC @ PSPE then mox & pyr @ 4N	53	73	*63*
Ave			*21*	*37*	*29*
LSD $_{Herb}$ (P<0.05)				*9*	
LSD $_{Var}$ (P<0.05)				*4*	
LSD $_{Herb*Var}$ (P<0.05)				*12*	

B. August 29

Active ingredient (g/ha)	Application Rate (gai/ha)	Application Timing	PBA Hallmark XT	SP1333	Ave
Imazamox & Imazapyr	24.75 & 11.25	PSPE	3	62	*33*
Imazamox & Imazapyr	24.75 & 11.25	4N	4	100	*52*
GpC	X1	PSPE	33	8	*21*
GpC	X1	4N	23	0	*12*
Nil			0	0	*0*
GpC + Imazamox & Imazapyr	X0.5 & 5.63	PSPE	3	0	*2*
GpC + Imazamox & Imazapyr	X0.5 & 5.63	4N	30	90	*60*
Imazamox & Imazapyr then GpC	24.75 & 11.25 then x1	mox & pyr @ PSPE then GpC @ 4N	27	50	*38*
GpC then Imazamox & Imazapyr	X1 then 24.75 & 11.25	GpC @ PSPE then mox & pyr @ 4N	57	100	*78*
Ave			*20*	*46*	*33*
LSD $_{Herb}$ (P<0.05)				*15*	
LSD $_{Var}$ (P<0.05)				*6*	
LSD $_{Herb*Var}$ (P<0.05)				*19*	

- Biomass: At flowering, biomass was correlated with herbicide damage. PBA Hallmark XT showed a 30-70% reduction in biomass in all treatments that contained GpC except the PSPE mix, where application rates were half of the individual treatments (Table 2A). In contrast, the mixed treatment applied 4N caused similar biomass reduction (35%) to the 4N GpC, slightly less than the PSPE application (50%). The sequence of GpC applied PSPE then 'imazamox & imazapyr' at 4N resulted in the greatest biomass reduction of 50%, supporting herbicide damage scores. There was no significant reduction in biomass from the 'imazamox & imazapyr' individual treatments, consistent with previous research. In contrast, SP1333 showed no significant reduction in biomass from the GpC individual treatments, consistent with previous research (Table 2A). However, significant biomass reductions (50-100%) were observed from all treatments that contained 'imazamox & imazapyr' except the PSPE mix, where application rates were half of the individual treatments. The 4N application of 'imazamox & imazapyr' resulted in death.
  At maturity, PBA Hallmark XT had recovered and there were no differences in biomass. In contrast, in SP1333, all treatments with 'imazamox & imazapyr' except the mix applied PSPE (at half rates), resulted in significant biomass reductions (Table 2B). Both treatments with the 4N application at full rates resulted in crop death.

- Grain Yield: Grain yield showed a similar trend to biomass at maturity. PBA Hallmark XT had recovered and no significant differences in grain yield were observed (Table 3). In SP1333, both treatments with the 4N application at full rates resulted in crop death. 'Imazamox & imazapyr' applied PSPE at the full rate and in sequence (at the 4N stage) with GpC resulted in grain yield loss of 60% and 40%, respectively. The was no significant grain yield loss in the mix treatment applied PSPE.

  These results highlight the benefits of combining improved group C herbicide tolerance with the 'imidazolinone' tolerance of varieties like PBA Hallmark XT. The traits combined will provide a more complete herbicide management package for lentils into the future. The results also suggest that in the 'imidazolinone' tolerant varieties, the use of Group C products at sowing, may increase sensitivity to in crop use of 'imidazolinone' products.

Table 2. Biomass (t/ha) at A. flowering and B. maturity of PBA Hallmark XT and SP1333 from application of 'imazamox & imazapyr' and 'GpC' post sowing pre-emergent and or 4N and individually, in sequence or in combination, at Horsham, Victoria in 2019.

A. Flowering

Active ingredient (g/ha)	Application Rate (gai/ha)	Application Timing	PBA Hallmark XT	SP1333	*Ave*
Imazamox & Imazapyr	24.75 & 11.25	PSPE	2.87	0.68	*1.78*
Imazamox & Imazapyr	24.75 & 11.25	4N	3.01	0.00	*1.51*
GpC	X1	PSPE	1.47	2.46	*1.97*
GpC	X1	4N	1.88	2.37	*2.13*
Nil			3.04	2.76	*2.90*
GpC + Imazamox & Imazapyr	X0.5 & 5.63	PSPE	2.86	2.11	*2.49*
GpC + Imazamox & Imazapyr	X0.5 & 5.63	4N	1.97	1.09	*1.53*
Imazamox & Imazapyr then GpC	24.75 & 11.25 then x1	mox & pyr @ PSPE then GpC @ 4N	2.06	1.44	*1.75*
GpC then Imazamox & Imazapyr	X1 then 24.75 & 11.25	GpC @ PSPE then mox & pyr @ 4N	0.97	0.00	*0.49*
Ave			*2.24*	*1.43*	*1.84*
LSD $_{Herb}$ (P<0.05)				*0.60*	
LSD $_{Var}$ (P<0.05)				*0.27*	
LSD $_{Herb*Var}$ (P<0.05)				*0.80*	

B. Maturity

Active ingredient (g/ha)	Application Rate (gai/ha)	Application Timing	PBA Hallmark XT	SP1333	*Ave*
Imazamox & Imazapyr	24.75 & 11.25	PSPE	7.40	4.29	*5.85*
Imazamox & Imazapyr	24.75 & 11.25	4N	7.51	0.00	*3.76*
GpC	X1	PSPE	6.63	6.99	*6.81*
GpC	X1	4N	7.52	8.20	*7.86*
Nil			7.68	8.76	*8.22*
GpC + Imazamox & Imazapyr	X0.5 & 5.63	PSPE	8.39	7.96	*8.18*
GpC + Imazamox & Imazapyr	X0.5 & 5.63	4N	7.23	4.62	*5.93*
Imazamox & Imazapyr then GpC	24.75 & 11.25 then x1	mox & pyr @ PSPE then GpC @ 4N	6.86	5.24	*6.05*
GpC then Imazamox & Imazapyr	X1 then 24.75 & 11.25	GpC @ PSPE then mox & pyr @ 4N	6.42	0.00	*3.21*
Ave			*7.29*	*5.18*	*6.24*
LSD $_{Herb}$ (P<0.05)				*1.56*	
LSD $_{Var}$ (P<0.05)				*0.66*	
LSD $_{Herb*Var}$ (P<0.05)				*2.08*	

Table 3. Grain Yield (t/ha) of PBA Hallmark XT and SP1333 from application of 'imazamox & imazapyr' and 'GpC' post sowing pre-emergent and or 4N and individually, in sequence or in combination, at Horsham, Victoria in 2019.

Active ingredient (g/ha)	Application Rate (gai/ha)	Application Timing	PBA Hallmark XT	SP1333	*Ave*
Imazamox & Imazapyr	24.75 & 11.25	PSPE	1.98	0.67	*1.33*
Imazamox & Imazapyr	24.75 & 11.25	4N	2.44	0.00	*1.22*
GpC	X1	PSPE	1.80	1.41	*1.61*
GpC	X1	4N	2.22	1.80	*2.01*
Nil			2.06	1.58	*1.82*
GpC + Imazamox & Imazapyr	X0.5 & 5.63	PSPE	2.49	1.99	*2.24*
GpC + Imazamox & Imazapyr	X0.5 & 5.63	4N	2.11	0.97	*1.54*
Imazamox & Imazapyr then GpC	24.75 & 11.25 then x1	mox & pyr @ PSPE then GpC @ 4N	1.88	1.22	*1.55*
GpC then Imazamox & Imazapyr	X1 then 24.75 & 11.25	GpC @ PSPE then mox & pyr @ 4N	1.63	0.00	*0.82*
Ave			*2.07*	*1.10*	*1.58*
LSD $_{Herb}$ (P<0.05)				*0.43*	
LSD $_{Var}$ (P<0.05)				*0.16*	
LSD $_{Herb*Var}$ (P<0.05)				*0.53*	

Acknowledgements
The research undertaken as part of the GRDC funded Southern Pulse Agronomy project is made possible by the significant contributions of growers through both trial cooperation and the support of the GRDC and the authors would like to thank them for their continued support. The continued assistance in trial management from AgVic and Frontier Farming teams is gratefully acknowledged and appreciated. The authors would also like to gratefully acknowledge private agronomists, pulse breeders, pathologists for their scientific input and assistance, as well as growers involved in the project.