

# Evaluating management strategies to reduce pod shatter in lentils

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## Key findings

- In 2022, pod shatter (seeds/m<sup>2</sup>) was affected by variety selection and time of harvest (TOH), as strong winds between TOH 1 and TOH 2 were conducive to seed loss. In 2023 conditions between TOH 1 and 2 were mild and there were no noticeable differences in pod shatter.
- Variety selection influenced seed and pod loss, with PBA Jumbo2 being among the best performing varieties for yield and losses.
- The application of EnviroShield® at green pod or desiccation had no effect on seed loss or final grain yield (t/ha) across two seasons at Hart.
- Although PBA Kelpie XT is resistant (R) for pod shatter, it recorded higher losses (1.8% of total yield) than moderately resistant (MR) rated variety PBA Highland XT (0.3% of total yield) in 2022.

## Introduction

Pre-harvest seed losses are an issue for most lentil growers due to impacts of pod shatter or pod drop reducing harvested yield. Unfavourable weather conditions leading into harvest including high temperatures and wind events damage pods, increasing pod shatter and seed loss (Parker et. al., 2021). Plant breeding has played an important role in improving the resilience of lentil varieties to pod shatter, however in many cases seasonal conditions and management practices still result in losses (Parker et. al., 2021).

In addition to plant breeding, pod protector or plant growth regulator (PGR) products are being explored for their ability to improve the strength of lentil pods or influence canopy structure to prevent seed losses. New research aims to understand production losses on farm (\$/ha), resulting from seed loss and evaluate novel management strategies to improve lentil seed retention.

Trials at Hart, SA from 2022 – 2023 investigated variety selection, harvest timing and pod protector product EnviroShield® as management tools to reduce pod shatter in lentils.

## Methodology

In 2022, a two-year trial investigating lentil pod shatter was established at Hart, SA (Table 1). This trial included four varieties, two application timings and two times of harvest. Four lentil varieties with varying maturity and pod shatter resistance were tested, including PBA Blitz, PBA Highland XT, PBA Kelpie XT and PBA Jumbo2 (Table 2). Time of harvest (TOH) was evaluated to compare a standard (harvesting on time) and late harvest. The late harvest timing occurred approximately 2 weeks after TOH 1 and was dependent on weather conditions post TOH 1.

A foliar applied product EnviroShield® was selected to trial across two seasons at Hart. EnviroShield® is a polymer pod protector aiming to provide benefits of a protective coating on the pod to reduce shattering across numerous crop types prone to seed loss.

Two application timings were trialed with foliar sprays applied at green pod (most pods reached final size but are still green) and desiccation, as a pre-harvest application. All applications of EnviroShield were applied at 1 L/ha (100 L water rate). Selected varieties were treated with EnviroShield® for a standard harvest timing, however all varieties were treated for late TOH treatments in both seasons (Table 3).

Table 1. Site details for 2022 and 2023 lentil pod shatter trial at Hart, SA.

<b>2022</b>	<b>Plot size</b>	1.75 m x 10.0 m	<b>Fertiliser</b>	Seeding: MAP Zn 1% @ 80 kg/ha
	<b>Seeding date</b>	May 12, 2022		
	<b>Harvest date</b>	Standard: November 29 Late: December 14	<b>Treatments</b>	Green pod: October 21 Desiccation: November 22
<b>2023</b>	<b>Plot size</b>	1.75 m x 10.0 m	<b>Fertiliser</b>	Seeding: MAP Zn 1% @ 80 kg/ha
	<b>Seeding date</b>	June 1, 2023		
	<b>Harvest date</b>	Standard: November 2 Late: November 15	<b>Treatments</b>	Green pod: October 6 Desiccation: October 26

Trials were managed with the application of pesticides to ensure a weed, insect and disease-free canopy. In 2022 and 2023 seasons, all plots were assessed for pod shatter by post-harvest seed counts (seeds/m<sup>2</sup>). In 2023, pod drop (pods/m<sup>2</sup>) was also measured post-harvest. All plots were assessed for grain yield (t/ha), 1000 grain weight and inspected for weather damage where required, including discoloration. Data was analysed using an ANOVA model in Genstat 23<sup>rd</sup> Edition.

Table 2. Lentil varieties with maturity, shatter and pod drop resistance ratings.

Variety	Maturity	Pod shatter resistance	Pod drop resistance
PBA Blitz	Early	MR	MR
PBA Highland XT	Early – mid	MR	MR
PBA Kelpie XT	Early – mid	R	MR
PBA Jumbo2	Mid	R	MR

\*MR = Moderately resistant, R = Resistant

Table 3. Treatment details for lentil pod shatter trial at Hart in 2022 and 2023.

Timing	TOH 2 (2022)		TOH 2 (2023)	
	Green pod	Desiccation	Green pod	Desiccation
Variety	*PBA Blitz	PBA Blitz,	*PBA Blitz	PBA Blitz
	PBA Kelpie	PBA Kelpie	PBA Kelpie	PBA Kelpie
	PBA Highland	PBA Highland	*PBA Highland	PBA Highland
	PBA Jumbo 2	PBA Jumbo 2	PBA Jumbo 2	PBA Jumbo 2

\*Varieties which were applied with EnviroShield at green pod for TOH 1 in each season.

## Results and discussion

### Time of harvest

Time of harvest (TOH) influenced pod shatter in 2022, with late harvest treatments showing higher losses (Figure 1).

In 2022, unfavourable weather conditions occurred between standard and late TOH, and significant pod shatter effects were noticed. Seven of the 15 days between harvest timings recorded wind gusts of more than 50 km/h, with 59 km/h wind gusts experienced the day prior to harvest (Table 4). As a result, PBA Kelpie XT and PBA Blitz recorded the highest seed losses from pod shatter of 111.5 and 122.3 kg/ha, respectively (Figure 1). Although losses from pod shatter were observed, this did not impact overall grain yield (t/ha).

The effects of TOH on pod shatter were not evident in 2023, likely resulting from mild conditions between the two harvest timings. Only two of the 13 days between standard and late harvest experienced strong wind gusts of more than 50km/h (Table 4). Although there was no difference in pod shatter between TOH 1 and 2, late harvest resulted in a 0.4 t/ha yield penalty. High pod losses from delayed harvest may have contributed to this yield reduction (Table 5). Pod drop was measured in 2023 only (one year of data).

Table 4. Weather conditions for the week prior to standard harvest and for all days between standard and late harvest timings for both seasons.

Year	Weather conditions	TOH 1	TOH 2
2022	Average daily maximum temperature (°C)	22.5	22.9
	Days with wind gusts > 50 km/h	1 of 7	7 of 15
	Average wind speed (km/h)	17.1	20.5
2023	Average daily maximum temperature (°C)	23.7	28.9
	Days with wind gusts > 50 km/h	1 of 7	2 of 13
	Average wind speed (km/h)	22.4	22.6

### Variety

Pod shatter resistance varied between the four varieties trialed at Hart (Table 2), with PBA Jumbo2 and PBA Kelpie XT both rated resistant (R) for pod shatter.

At Hart in 2022, PBA Jumbo2 yielded higher than PBA Kelpie XT, PBA Blitz and PBA Highland XT (Table 5). Although PBA Kelpie XT is rated R for pod shatter, it recorded higher losses (1.8% of total yield) than MR rated variety PBA Highland XT (0.3% of total yield) in 2022.

In 2023 no differences in pod shatter were noticed between varieties, however there was a variety effect on pod drop ( $P < 0.001$ ). Pod loss (measured as pods/m<sup>2</sup>) was lowest for PBA Jumbo2 (4.8% of total yield), with PBA Kelpie recording the highest amount of pod drop (19.9%) (Table 5).

Table. 5 Yield and % yield loss from pod shatter and pod drop in 2022 and 2023. Significant differences are indicated by different letters. Shaded values indicate best performing treatments.

	Treatment	Yield (t/ha)	% yield loss from pod shatter	% yield loss from pod drop
2022	PBA Blitz	3.57 <sup>a</sup>	2.2 <sup>b</sup>	-
	PBA Highland XT	3.76 <sup>a</sup>	0.3 <sup>a</sup>	-
	PBA Kelpie XT	3.73 <sup>a</sup>	1.8 <sup>b</sup>	-
	PBA Jumbo2	4.41 <sup>b</sup>	0.5 <sup>a</sup>	-
	<b>P value</b>	<b>P &lt; 0.001</b>	<b>P &lt; 0.001</b>	
	Standard harvest	3.77	0.6	-
	Late harvest	3.96	1.7	-
	<b>P value</b>	<b>NS</b>	<b>P &lt; 0.001</b>	
	EnviroShield® @ Green pod	3.91	1.6	-
	EnviroShield® @ Desiccation	3.99	1.8	-
	Nil	3.86	1.1	-
	<b>P value</b>	<b>NS</b>	<b>NS</b>	
	2023	PBA Blitz	2.06	2.7
PBA Highland XT		1.85	2.3	15.7 <sup>c</sup>
PBA Kelpie XT		1.83	1.9	19.9 <sup>c</sup>
PBA Jumbo2		1.94	0.4	4.8 <sup>a</sup>
<b>P value</b>		<b>NS</b>	<b>NS</b>	<b>P &lt; 0.001</b>
Standard harvest		2.13	1.0	9.6
Late harvest		1.71	2.7	15.5
<b>P value</b>		<b>P = 0.003</b>	<b>NS</b>	<b>P = 0.018</b>
EnviroShield® @ green pod		1.89	1.6	12.1
EnviroShield® @ desiccation		1.77	2.3	11.6
Nil		1.92	1.7	11.8
<b>P value</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>	

#### Application of EnviroShield®

EnviroShield® applications at 1 L/ha (100 L water rate) had no effect on pod shatter when applied at green pod or desiccation across two seasons at Hart (Table 5). Further investigation into application rates and timings would provide additional information to make informed management decisions.

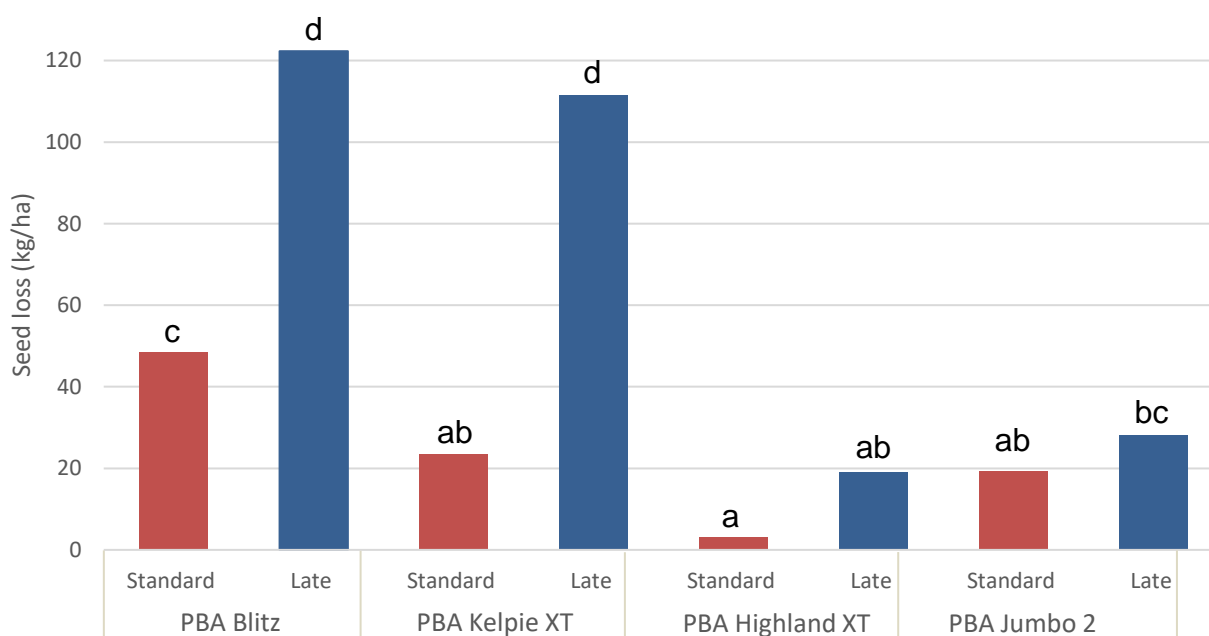


Figure 1. Seed loss (pod shatter) for all varieties and harvest times at Hart in 2022. Significant differences in seed loss (kg/ha) from pod shatter between treatments are indicated by different letters.

### Summary

Variety selection and time of harvest impacted yield losses from pod shatter in 2022 when windy conditions were present prior to harvest, however losses were not significant when considering total yield.

Seasonal variation in variety performance was noticed, however PBA Jumbo performed well for yield and pod shatter in both seasons of the trial. In 2023, the majority of losses were as a result of pod drop rather than pod shatter, which was not measured in the first year of the trial.

EnviroShield® applied as a foliar spray at green pod or desiccation had no yield or pod shatter effect for any treatment across both seasons. Further investigation into application rates and timings would provide additional information to make informed management decisions.

Variety selection and timely harvesting are critical for reducing pod shatter losses in years where conditions may be unfavourable leading into harvest, however additional management strategies should be further explored over several years.

### Acknowledgements

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### References

Parker, T. A., Lo, S., Gepts, P., (2021) Pod shattering in grain legumes: emerging genetic and environment-related patterns, *THE PLANT CELL*, 33: 179-19