SA Grain Legume Development and Extension Project

Summary of 2021 Field Trial Results

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

THE UNIVERSITY of ADELAIDE

Government of South Australia
Department of Primary Industries and Regions

SARDI RESEARCH AND DEVELOPMENT INSTITUTE

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Project management

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Project Investment

Grains Research and Development Corporation: project UOA2105-013RTX "Development and extension to close the economic yield gap and maximise faming systems benefits from grain legume production in South Australia"

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Cover image: Melrose salt tolerant lentil variety trial, 10 September 2021

INTRODUCTION

The project aims to deliver local development and extension to close the economic yield gap and maximise faming systems benefits from grain legume production in South Australia.

Over the lifeline of the project (2021-2025), the proposed investment will:

- Address the current yield gap in grain legumes and drive its closure through supporting increased technical efficiency of growers with extension of best practice grain legume agronomy;
- Support grain growers and their advisers (100 per hub, 20 per spoke) in the target regions (Figure 1) to maximise system profitability by incorporating grain legumes in rotation;
- Drive and support sustainable expansion of the area grown to grain legumes; and
- A targeted 45% of growers adopt or intend to adopt new and novel practices emerging from linked proof-of concept and innovation research

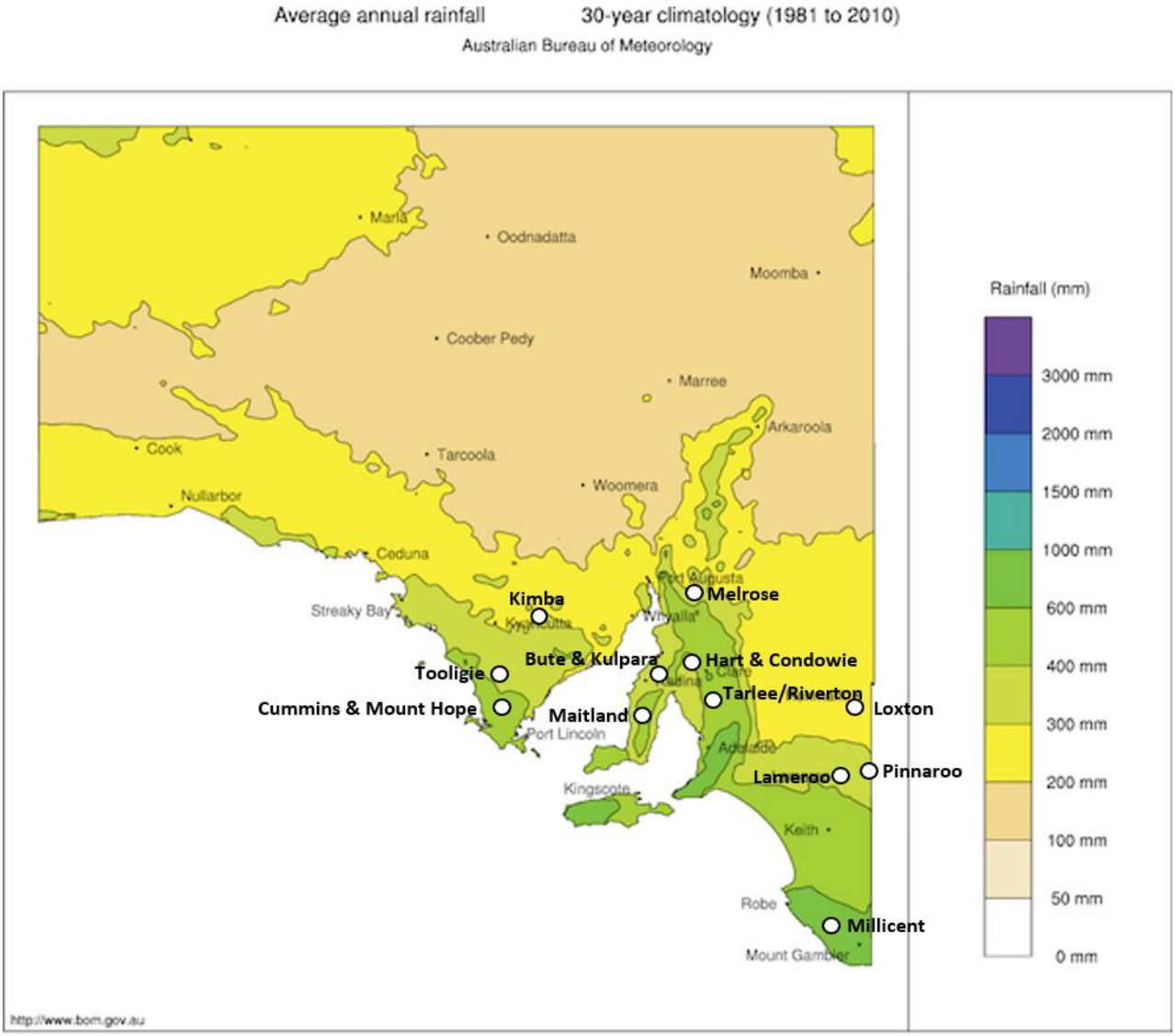

Figure 1. Trial locations for SA Grain Legume hub and spoke sites in 2021, selected by collaborators to represent the range of environments and soil types across the state's legume cropping regions.

TOOLIGIE

SITE SUMMARY

Following above average rainfall in the pre-season, April rainfall was well below-average at Tooligie in 2021 (Figure 2). While May rainfall was above average, of the 34 mm received, 23 mm of this did not fall until late in the month. As a result, trial sowing was delayed until 10th June. Fortunately, germination was not affected by the delay, and June and July rainfall were above average (57 mm and 62 mm respectively) and sufficient for crops to survive on throughout winter. Temperatures did not reach 0°C at any stage during the growing season (Figure 3) and no frosts were recorded; however, crops had poor vigour and canopy closure was not achieved. In the second half of the growing season, August and September rainfall were below average (Figure 2) resulting in moisture stress. Substantial October and November rainfall did not improve the crop condition, and delayed harvest until the 25th of November. No grain cracking was recorded following delayed harvest at Tooligie.

The site soil is a clayey loam interspersed with a sandy loam layer from 10-30 cm, with a neutral-alkaline pH and moderate soil nitrogen and Colwell phosphorus (Table 1). No obvious production constraints were identified from the soil profile analysis.

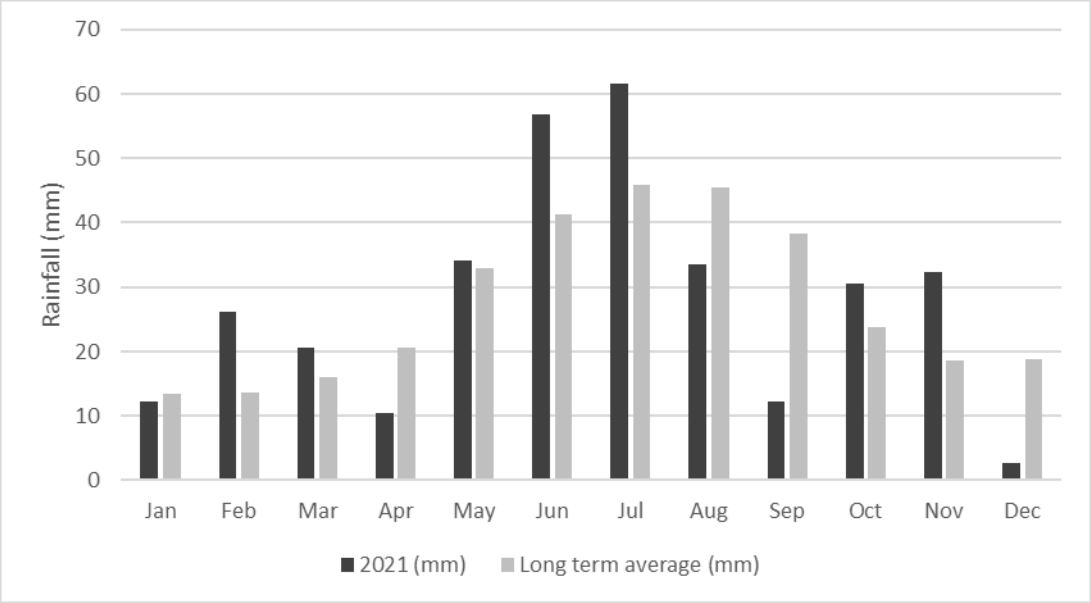

Figure 2. Monthly rainfall at Tooligie in 2021 compared to the long-term average recorded at Murdinga BOM weather station (#018164).

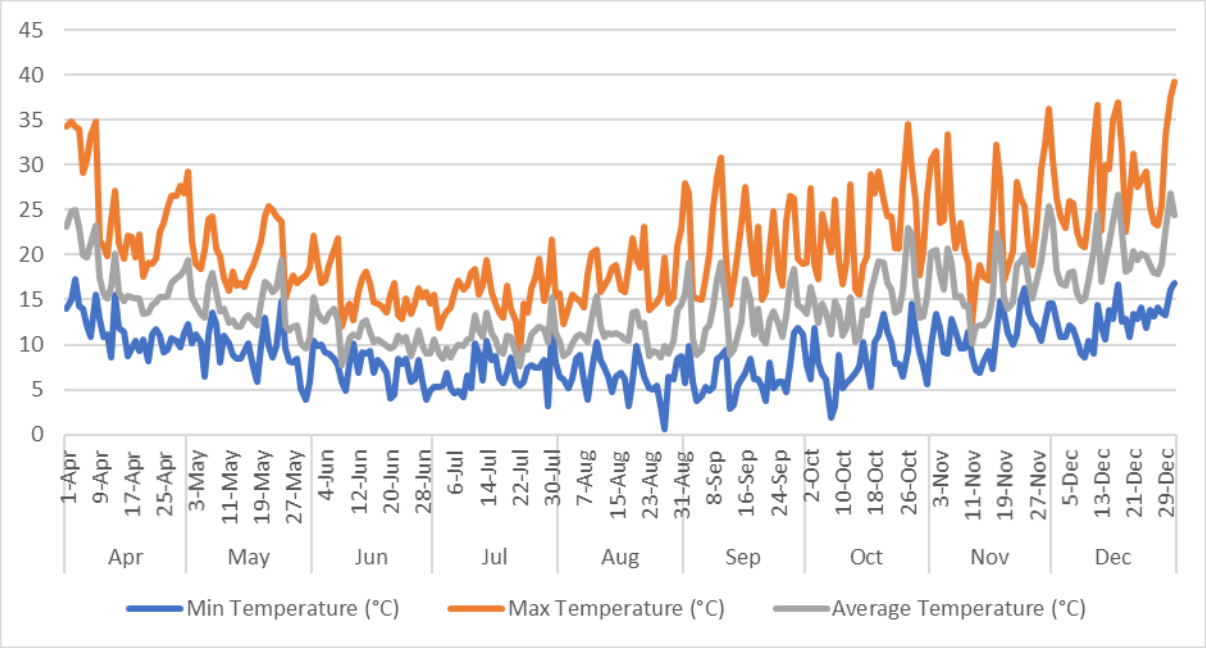

Figure 3. Minimum, maximum and average daily temperatures recorded at Tooligie, 2021.

Table 1. Soil characterisation (clay loam/sandy loam) at Tooligie trial site, 2021.

Depth (cm)	NH_3-N	NO_3-N	P (mg/kg)	K	S	OC (%)	EC (dS/m)	pH ($CaCl_2$)	pH (H_20)
0-10	1	20	30	571	10.3	1.62	0.235	7.3	7.8
10-30	1	11	8	363	33.7	0.78	0.462	8.0	9.1
30-60	<1	8	9	454	57.6	0.54	0.827	8.4	9.8
60-90	<1	5	3	464	80.7	0.33	1.146	8.6	10.1

Depth (cm)	Cu	Fe	Mn (mg/kg)	Zn	B	Exc Ca	Exc Mg	Exc K (meq/100g)	Exc Na	Exc Al
0-10	0.63	13.00	3.08	0.76	4.24	21.75	3.83	1.57	0.76	0.050
10-30	0.49	14.60	1.57	0.31	13.11	15.53	6.67	0.97	2.92	0.060
30-60	0.59	15.30	1.58	0.38	24.18	9.41	9.81	1.17	6.27	0.040
60-90	0.62	12.70	0.93	0.22	27.11	6.60	7.57	1.26	10.65	0.040

REDUCING SHATTERING IN HIGH WIND CONDITIONS

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Aim: To assess pod loss and shattering of different varieties, and to assess the impact of harvest timing and Pod Ceal® on lentil pod retention.

Methodology:

Trials were established in 2021 (Table 2) and managed with as per best practice. In-season measurements are summarised below:

Plant establishment counts were recorded by placing a 1 m ruler in two random locations in each plot and counting the number of plants in the middle two rows along the ruler.

Immediately prior to harvest, plots were assigned a lodging, pod shatter and pod drop score. Lodging was scored on a scale of 1-9, where 1 = flat and 9 = erect. Pod shatter and pod drop were measured in season, prior to harvest.

Pod drop is defined as the loss of unopened pods that fall from the plant caused by the peduncle breaking. Pod shatter is defined as the loss of seeds due to the pod breaking apart prior to harvest.

Pod drop and pod shatter were measured by counting the number of pods or grains on the ground on either side of a 0.5 m ruler placed between two rows, in two random areas in the plot immediately prior to harvest.

All plots were harvested using an experimental harvester. Total plot grain weight was recorded and used to determine grain yield on a t/ha scale. A sub-sample of grain was retained for grain quality assessments.

Data was analysed using a split-plot ANOVA in Genstat 21st edition (Table 2).

Treatments

Varieties: 12H037L-3-15HSHI3005, 11H258L-14HHI4001, 11H199L-14H4001, GIA Leader, SP1333*, PBA Jumbo2.

*SP1333 was only included in two replications.

Harvest timing:

- Timely harvest: within 5-7 days post-desiccation. Actual harvest was 13 days post-desiccation due to rainfall post-desiccation.
- Delayed harvest: within 12-15 days post-desiccation. Actual harvest was 23 days post-desiccation due to rainfall post-desiccation.

Pod Ceal®: Half of each plot was sprayed with Pod Ceal®.

Table 2. Trial details, including sowing and harvest date, at Tooligie 2021.

Trial design	Split- plot (Whole plot = Harvest timing; Sub-plot = Variety)
Replicates	3
Sowing date	10/06/2021
Plant density	120 plants/m^2
Row spacing	25 cm
Fertiliser	80 kg/ha MAP
Harvest date	Timely 08/11/2021, Delayed 18/11/2021

Key messages:

- Pod Ceal® had negative effects on pod drop and pod shatter losses in lentil at Tooligie in 2021.
- Varietal selection was the most important factor influencing grain yield.
- Delayed harvest was associated with higher yields compared to a timely harvest.

Results and discussion:

Following above-average June and July rainfall, August and September were dry with below average rainfall at Tooligie. Crops at the site did not reach canopy closure due to seasonal conditions. October and November rainfall did not improve crop condition, though it did delay harvest. A significant hail and wind event occurred in late October. No frosts were recorded at the site in 2021.

Pod Ceal® had a negative effect on both pod drop and pod shattering at Tooligie in 2021 (data not shown), increasing the losses from both measurements. This is difficult to explain with the limited data set and requires further investigation.

There were no differences in pod drop or pod shatter numbers between the two harvest timings (Table 3). This is likely due to weather conditions leading up to both harvest events. In the week prior to timely harvesting weather conditions were drier and less humid compared to the week leading up to the delayed harvest (Table 4). Therefore, the crop was drier and more brittle, which could have led to increased pod losses. In the period between the timely and delayed harvest, there was substantial rainfall and increased humidity, meaning the plants were more turgid; likely minimising pod drop and shattering. This requires further investigation and would be an interesting topic for future studies.

Varietal selection was an important factor when considering pod drop and pod shatter losses at the Tooligie site in 2021. PBA Jumbo2 had equal lowest pod drop to SP1333, GIA Leader and 11H199L-14H4001 (Figure 4). However, PBA Jumbo2 had equal highest pod shatter losses to 11H199L-14H4001 (Figure 5). Pod shatter is largely driven by genetics and can be exacerbated by dry conditions (Parker *et al.* 2021) whereas evidence suggests that pod drop is mostly driven by environmental conditions such as temperature, humidity, and moisture (Erskine 1985), and there was no correlation between the two measurements in this study (data not shown). The outcome of varietal differences in both pod drop and pod shatter in this trial, requires further investigation.

Varietal selection was important for grain yield at Tooligie, 2021 (Figure 6). PBA Jumbo2 yielded equal to GIA Leader, 12H037L-3-15HSHI3005 and 11H258L-14HHI4001. Interestingly, pod drop and pod shatter values did not translate into yield; for example, SP1333 had some of the lowest pod drop and pod shatter values but was amongst the lowest yielding varieties (Figure 4 to Figure 6).

Delaying harvest after desiccation resulted in an average yield increase of 161 kg/ha over a timely harvest (Figure 7), the reason for this being unclear. There was no interaction between harvest timing and lentil variety selection ($P>0.05$).

From this limited data set there was no benefit to applying Pod Ceal®. However, seasonal conditions such as rainfall, wind events and temperature will have an impact on the outcomes, and consecutive years of data is necessary to draw accurate conclusions on this topic, especially given the high degree of variability in the trial data (Table 3).

Table 3. Pod drop (pod/m^2) and pod shatter (grains/m^2) results from Tooligie in 2021.

	Pod Drop			Pod Shatter		
Variety	*Timely harvest*	*Delayed harvest*	*Avg.*	*Timely harvest*	*Delayed harvest*	*Avg.*
SP1333	50.7	18.7	34.7	21.3	6.7	14.0
GIA Leader	61.3	30.7	46.0	5.3	25.3	15.3
PBA Jumbo2	38.7	17.3	28.0	37.3	57.3	47.3
11H199L-14H4001	49.3	30.7	40.0	53.3	42.7	48.0
12H037L-3-15HSHI3005	80.0	62.7	71.3	14.7	10.7	12.7
11H258L-14HHI4001	124.0	48.0	86.0	41.3	22.7	32.0
Average	67.3 ± 38.4	34.7 ± 24.9		28.9 ± 23.4	27.6 ± 21.7	
LSD (p≤0.05)						
Timing	n.s.	n.s.		n.s.	-	
Variety	27.56	-		20.32	-	
Timing x variety	n.s.	n.s.		n.s.	-	

Table 4. Weather data in the week prior to both harvest timings at Tooligie in 2021. Rainfall is the total amount received in the week prior to harvest. Humidity and temperature are the averages from the site during the week prior, collected from weather station data.

	Harvest timing	
	Timely	**Delayed**
Rainfall (mm)	3	13
Humidity (%)	54	66
Temperature (°C)	18	14

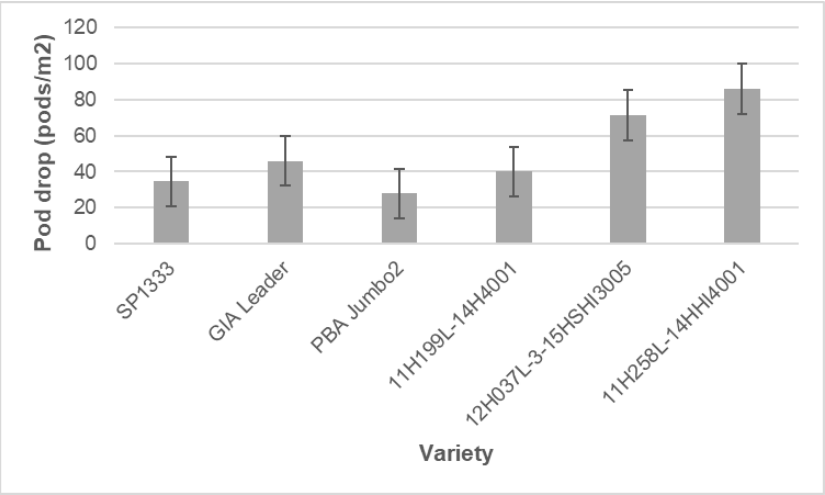

Figure 4. Pod drop measured in lentil at Tooligie in 2021. Bars labelled with the same letters are not significantly different (P≤0.05). Error bars represent least significant difference (P≤0.05).

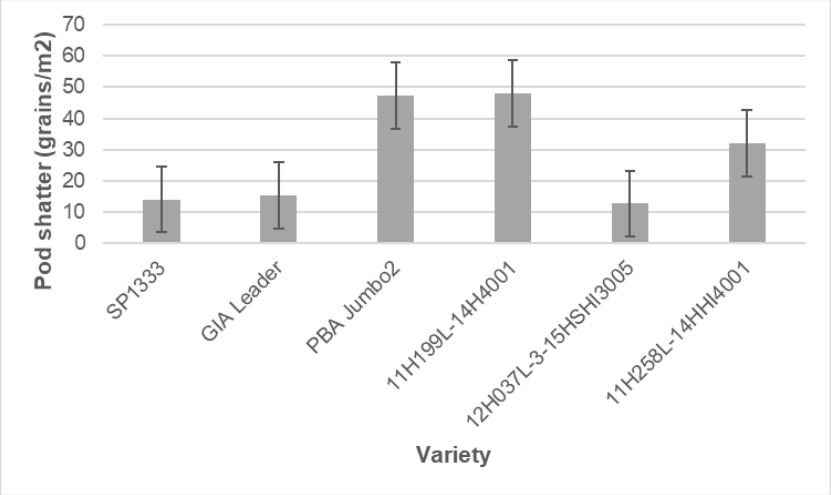

Figure 5. Pod shatter losses in lentil at Tooligie in 2021. Bars labelled with the same letters are not significantly different (P≤0.05). Error bars represent least significant difference (P≤0.05).

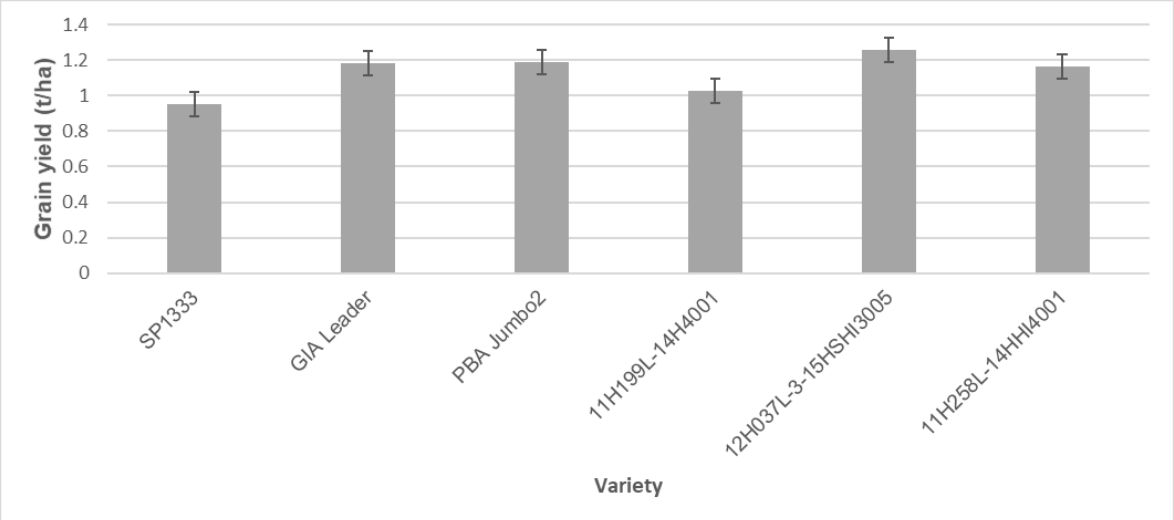

Figure 6. Grain yield of lentil varieties at Tooligie in 2021. Bars labelled with the same letter are not significantly different (P≤0.05). Error bars represent least significant difference (P≤0.05).

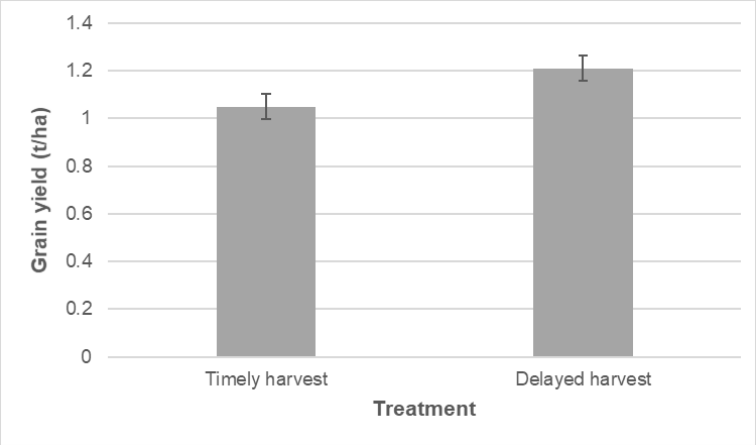

Figure 7. Lentil yields at Tooligie in 2021, with timely and delayed harvest post-desiccation. Error bars represent least significant difference (P≤0.05).

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