

Pre-harvest rain reduces lupin seed quality

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Key messages

- 40% lower germination was measured from seed off plants exposed to wetting and drying at maturity.
- Lupin grain being kept for seed should be harvested as soon as it is ripe to minimise the chance of rain on mature plants.

Aims

The aim of this trial series was to investigate whether wetting and drying of mature lupin seed reduced seed germination.

Background

Observations of farmer paddocks over many years suggest that seed germination is reduced when mature lupin seed in the pod is exposed to rain prior to harvest. However, there is no empirical data to support this. In 2015 the variety PBA Jurien was released with reports of poor establishment of the seed. The seed crops received over an inch of rain while standing mature in the paddock prior to harvest which, if previous observations are correct may explain the poor germination of the seed. A set of trials was run to test the hypothesis that seed from lupin plants which have received moisture at crop maturity, but prior to harvest, have reduced germination.

Methods

Trial 1: Field trial investigating the effect of post maturity rain on the quality of the seed

Single row 1 metre plots were sown with 5 plants per plot at DPIRD's Geraldton Research Annex on May 5 2016. Four replicates were grown to maturity. At maturity all five plants in each plot were cut at the base of the stem, bunched together and supported by stakes. Plastic sheeting was wrapped around each bunch/plot of lupins and sealed at the base. Treatment applications of irrigation to simulate a rainfall event were applied using a pressurised sprayer to ensure complete plant coverage. After the application of water the plastic was sealed at the top to ensure treatments remained at high humidity. After each irrigation treatment the plastic remained sealed for 48 hours. After this time the plastic was removed and plants left to dry. Dates of harvest were 31 Oct (no irrigation), 14 Nov (1 irrigation), 28 Nov (2 irrigations) and 15 Dec (3 irrigations).

The plants were under a rain-out shelter to ensure rain did not wet them and confound treatment effects. Seed was collected from each plot as soon as the plants were dry from their last irrigation treatment. Seed was germination tested as per International Seed Testing Association (ISTA) rules for lupin.

Table 1. Trial 1 treatments.

Trt	Variety	# of Irrigations	Comment
1	Gungurru	0	No wetting and drying of mature seed
2	Mandelup	0	No wetting and drying of mature seed
3	Jurien	0	No wetting and drying of mature seed
4	Gungurru	1	1 wetting and drying cycle on mature seed
5	Mandelup	1	1 wetting and drying cycle on mature seed
6	Jurien	1	1 wetting and drying cycle on mature seed
7	Gungurru	2	2 wetting and drying cycles on mature seed
8	Mandelup	2	2 wetting and drying cycles on mature seed
9	Jurien	2	2 wetting and drying cycles on mature seed
10	Gungurru	3	3 wetting and drying cycles on mature seed
11	Mandelup	3	3 wetting and drying cycles on mature seed
12	Jurien	3	3 wetting and drying cycles on mature seed

Trial 2: Field trial investigating the effect of delayed harvest without irrigation applied

This trial was located adjacent to trial one and managed in the same way except that irrigation was not applied and the plants were left exposed to the weather. Treatments were the same three varieties Mandelup, Jurien and Gungurru factorial with 4 harvest dates, there was little rain after plants were mature (Table 2).

Table 2. Harvest date and rain on plants of trial # 2.

Harvest date	mm of rain after plant maturity
31/10/2016	0.0
14/11/2016	1.4
28/11/2016	4.6
15/12/2016	6.6

Trial 3: Laboratory trial investigating the effect of post maturity moisture on seed quality

In this trial whole pods were taken from plants grown in a shade house as soon as plants were mature, 31 Oct. Treatments included the three varieties (Mandelup, Jurien and Gungurru) factorial with 4 incubation treatments. Incubation treatments included a control (no wetting of pods) ; 1 wetting and drying cycle (48 hours at 30°C); 2 wetting and drying cycles (96 hours at 30°C) and 3 wetting and drying cycles (144 hours at 30°C). For the wetting and drying procedure a wire rack was placed in each of three 35 x 15cm trays (one for each variety). Approximately 100 pods of each variety were placed on a wire rack (1 tray per variety). These pods were then thoroughly wet with 400mL of water using a pressure sprayer to ensure 100% coverage. The excess water drained to the 35 x 15cm tray below the wire racks and was left in the trays. Trays were then placed in an incubation cabinet set to 30°C. After this period they were removed and dried down naturally in a 20°C room. After drying down the seed was hand threshed from pods to ensure no mechanical damage and germination tested as per ISTA rules for lupin.

Results

Trial 1

For all varieties irrigation applied to the mature plant prior to harvest resulted in seed with lower germination (Table 3 and Figure 1). Averaged across varieties, when the pods were wet and dried once the germination of the seed was reduced by 4%; with 2 drying cycles germination dropped a further 15% and with three a further 26%. Hence seed germination was reduced by 43% when the pods went through three wetting/drying cycles and were harvested on December 15. There was no significant difference between the varieties used.

Table 3. Trial 1 germination (%)

Variety	# of irrigations prior to harvest				Average
	0	1	2	3	
Gungurru	86	89	62	52	72
PBA Jurien	82	80	62	37	65
Mandelup	82	68	69	25	61
Average	83	79	64	38	
F Prob variety					NS
Lsd variety					
F Prob Irrigation					<0.001
Lsd Irrigation					12.67
F Prob var*Irr					NS
Lsd Var* Irr					

Trial 2

Conditions after plant maturity were relatively dry compared to the irrigation treatments in Trial 1, hence the plants that were left in the open were subject to different conditions than the irrigated treatments. The germination percentage of the seed did drop when harvest was delayed from 31 Oct to the 15 Dec by 7%, after exposure to 6.6mm of rain. This was not statistically significant and was much lower than the 43% germination reduction in the irrigated treatments alongside (Table 4).

Table 4. Trial 2 germination (%)

Variety	Harvest date			Average
	31/10/2016	28/11/2016	15/12/2016	
Gungurru	83	85	77	82
PBA Jurien	83	69	76	76
Mandelup	75	63	71	70
Average	81	73	74	
F Prob Variety				0.01
Lsd Variety				7.1
F Prob Harv date				NS
Lsd Harv date				
F Prob Var * Harv				NS
Lsd Var*Harv				

Trial 3

Exposing mature seed in the seed pod to moisture decreased germination percentage. Averaged across varieties when the pods were wet and dried once germination of the seed was reduced by 6%, with 2 drying cycles germination dropped a further 5% and with three a further 24%. In total germination was reduced by 37% when the pods went through three wetting/drying cycles. The germination percentage of all varieties declined substantially due to wetting and drying of the seed. There was a variety by incubation day interaction that was significant. There was no difference in the germination percentage of varieties at 0, 2 and 4 days of incubation. At 6 days each variety had a significantly different germination percentage, Mandelup 74%, Gungurru 62% and PBA Jurien the lowest at 46% (Table 5).

Table 5. Trial 3 germination (%)

Variety	*Incubation duration (days)				Average
	0	2	4	6	
Gungurru	98	88	84	62	83
PBA Jurien	98	92	84	46	80
Mandelup	98	90	88	74	88
Average	98	90	85	61	
F Prob variety					0.020
Lsd Variety					5.20
F Prob incubation days					<.001
Lsd incubation days					6.01
F prob var*days					0.004
Lsd var*days					10.4

*Incubation = 30°C at 100% humidity

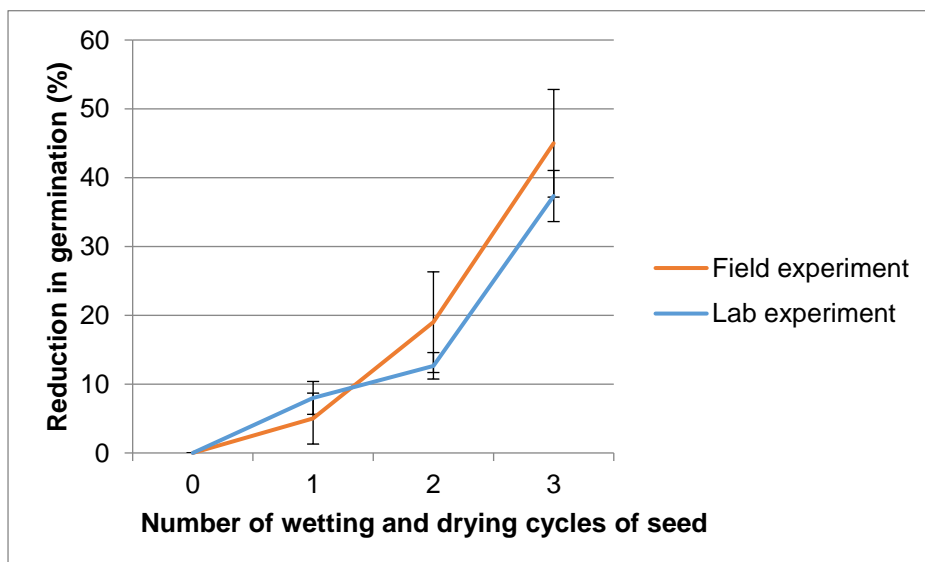


Figure 1. Summary of trials 1 and 3 in which water was applied to mature lupin seed in the pod.

Conclusion

This set of trials confirm the hypothesis that seed from lupin plants which have received moisture at crop maturity, but prior to harvest, have reduced germination. In trial 2 lupins remained relatively dry after maturity and delayed harvest resulted a 7% reduction in germination, this was not statistically significant. However in both field and laboratory trials where methods were used to put seed through wetting and drying cycles seed germination percentage decreased with each subsequent cycle. In these experiments exposure of seed to one wetting and drying cycle reduced seed germination by 5 to 10%; 2 cycles by 10 to 20% and 3 cycles by 35 to 45% (Figure 1). It should be noted that these reductions in germination percentage occurred in ideal laboratory germination conditions and it is likely that any reduction in lupin seed quality would have a larger effect on field establishment, particularly if field conditions are poor. In one of the three trials there was a variety response when seed was exposed to 3 cycles of wetting and drying, further testing is being done on a wider set of varieties to investigate this further.

The key message is that lupins which are going to be used for seed the next year should be harvested as soon as they are mature.

Key words

Lupin, germination, seed, viability

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