



Manipulating lupin alkaloid content with fertiliser and herbicide management

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Trial Background: For lupins to become accepted as a human consumption food source, the alkaloid level of the whole kernel must be less than 0.02% and the flour must fall under 0.015%. Management and treatment of lupin crops for human consumption needs to be done with the effects of alkaloid levels in mind. Hence, this trial tests the hypothesis that plant nutrition and crop-topping can affect a lupin plants ability to fill grain and thus influence alkaloid %.

Aim: To assess fertiliser, herbicide and rain exclusion treatments and their effects on grain yield and lupin alkaloid content.

Materials and Methods: Mandelup and Coromup lupin varieties were planted dry into yellow Eradu sandplain soils in dry conditions.

Basal fertilisers: 80 kg/ha of Super Potash 2:1 topdressed before sowing in March and 50kg of Big Phos TE banded below the seed at sowing. Combined these basal treatments supplied the crop with **11.63P : 13.04K : 9.91S : 19.64Ca : 0.10Cu : 0.10Zn**.

Treatment Application:

Treatments were replicated 3 times, except for the rain exclusion treatment, which was only replicated once in each variety. The Muriate of Potash treatments were applied by hand at approximately 10-12 leaf of the crop, on the 31st July 2009.

The Foliar Manganese treatments were sprayed when the crop had pods approximately 2cm long on the primary stem and the remaining branches were flowering, on the 16th August 2009. The treatments were applied at 16km/hr at 3 bar pressure, 88 litres/Ha through an 110 degree LD 03 nozzle. Plots were 20m in length by 3m in width.

The rain exclusion treatments or rain shelters eliminated September rainfall.

The gramoxone treatment (for weed desiccation) was applied at 80% leaf drop of the lupin crop (Mandelup only), which is considered the earliest safe timing to apply desiccants without affecting grain yield or quality.

Basal Herbicides: All plots were sprayed with 2L Trifluralin at sowing, 200ml Targa at 4-6 leaf, 500ml Simazine + 200ml Brodal + 80g Lexone at 10 leaf, and 500ml Select at approximately 12-14 leaf.

Yield and quality analysis – plots were harvested with a Kingaroy plot harvester. Plots were 20m in length by 1.3m in width. Plot yields were weighed immediately and bagged for analysis. Samples were analysed for alkaloid content by the Food and Agricultural Chemistry dept. at the Chemistry Centre of WA.

Observations:

There was no visual difference in vegetative growth of the lupin plots where Potash was applied at any rate.

Foliar Manganese treatments had no visible effect on lupin growth after application. Coromup lupin kernels appeared much larger and plumper than the Mandelup kernels at harvest time. The September rain exclusion treatments had very small grains and were shriveled in nature.

Results:

Table 1: Experimental Treatments:

1	nil			
2	Mantrac Twin (50% Manganese)	500	ml/ha	
3	Mantrac Twin (50% Manganese)	1000	ml/ha	
4	Mantrac Twin (50% Manganese)	1500	ml/ha	
5	Mantrac Twin (50% Manganese)	2000	ml/ha	
6	Muriate of Potash	50	kg/ha	
7	Muriate of Potash	100	kg/ha	
8	Mantrac Twin	1000	ml/ha	Muriate of Potash 50 kg/ha
9	Gramoxone	1400	ml	
10	Dry finish rain shelter	September	rain	Nil

Table 2: Grain Yield Results

Treatments	Rates	Coromup Lupins		Mandelup Lupins	
		% yield of Untreated	Yield kg/ha	% of Untreated	Yield kg/ha
1 nil		100	2895	100	3304
2 Mantrac Twin	500 ml/ha	108	3132	94	3094
3 Mantrac Twin	1000 ml/ha	104	3006	104	3431
4 Mantrac Twin	1500 ml/ha	102	2964	100	3291
5 Mantrac Twin	2000 ml/ha	100	2897	104	3428
6 Muriate of Potash	50 kg/ha	96	2791	97	3213
7 Muriate of Potash	100 kg/ha	100	2908	104	3422
8 Mantrac Twin	1000 ml/ha	Muriate of Potash	50 kg/ha	103	2990
9 Gramoxone				-	-
10 Dry finish rain shelter	No Sept rain			-	-
	LSD 0.01	11	314	17	557
	LSD 0.05	8	226	12	401
	CV		4.39		6.92

Mantrac Twin = 50% Manganese, Muriate of Potash 49% Potassium.



Table 3: Grain Alkaloid Content Results

Treatments		Rates		Coromup Lupins		Mandelup Lupins	
				% Alkaloid	Alkaloid	% of	Alkaloid
				Untreated	content %	Untreated	content
1	nil			100	0.0120	100	0.0170
2	Mantrac Twin	500	ml/ha	106	0.0127	114	0.0193
3	Mantrac Twin	1000	ml/ha	106	0.0127	116	0.0197
4	Mantrac Twin	1500	ml/ha	111	0.0133	114	0.0193
5	Mantrac Twin	2000	ml/ha	108	0.0130	92	0.0157
6	Muriate of Potash	50	kg/ha	78	0.0093	90	0.0153
7	Muriate of Potash	100	kg/ha	81	0.0097	90	0.0153
8	Mantrac Twin	1000	ml/ha	92	0.011	90	0.0153
9	Gramoxone			-		124	0.0210
10	Dry finish rain shelter		No Sept Rain	300	0.0360	418	0.0710
			LSD 0.01	27.6	0.0033	40.60	0.0069
			LSD 0.05	19.9	0.0024	29.47	0.0050
			CV		11.64		16.4846

Significant **reduction** / **increase** in alkaloid content ,



Figure 1: Alkaloid Content of Coromup Lupins

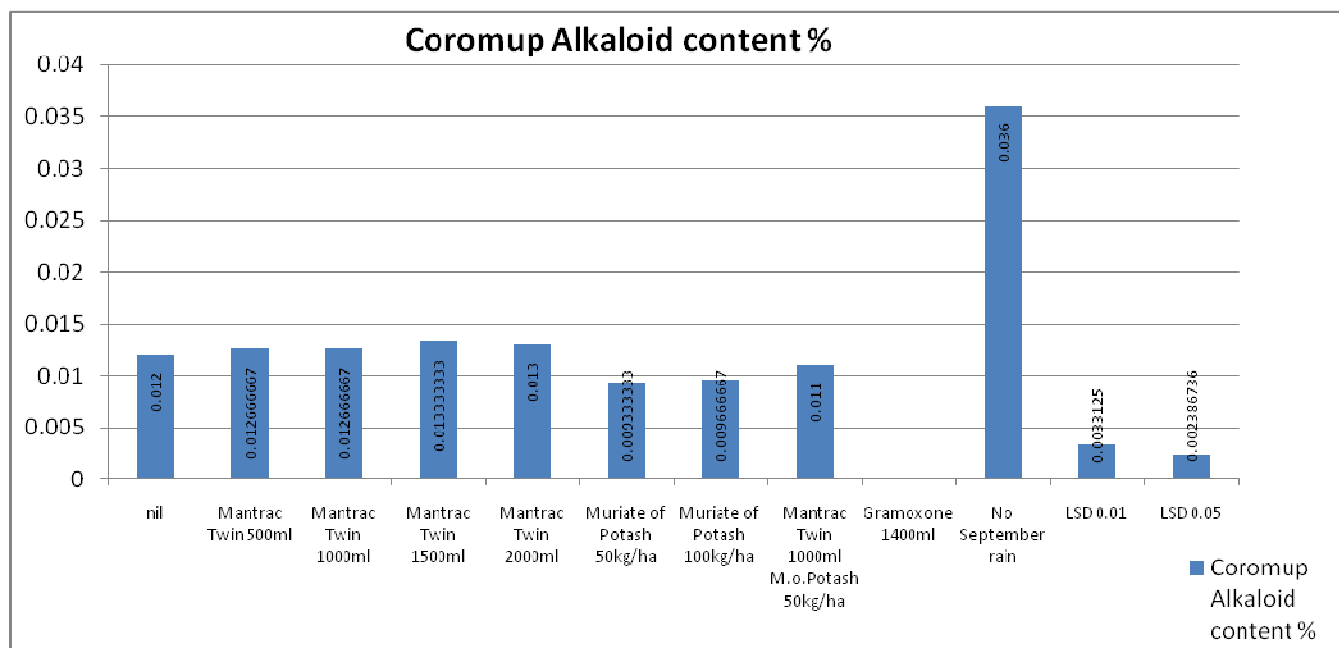


Figure 2: Alkaloid Content of Mandelup Lupins

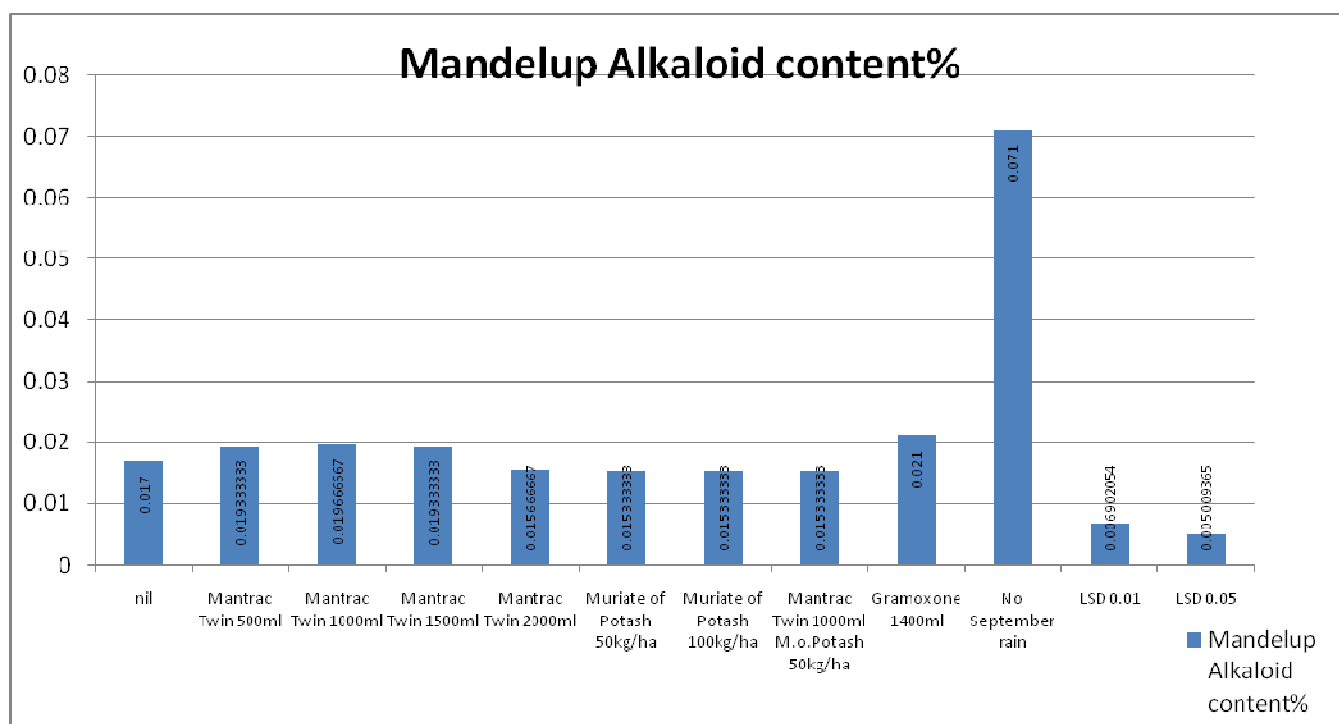
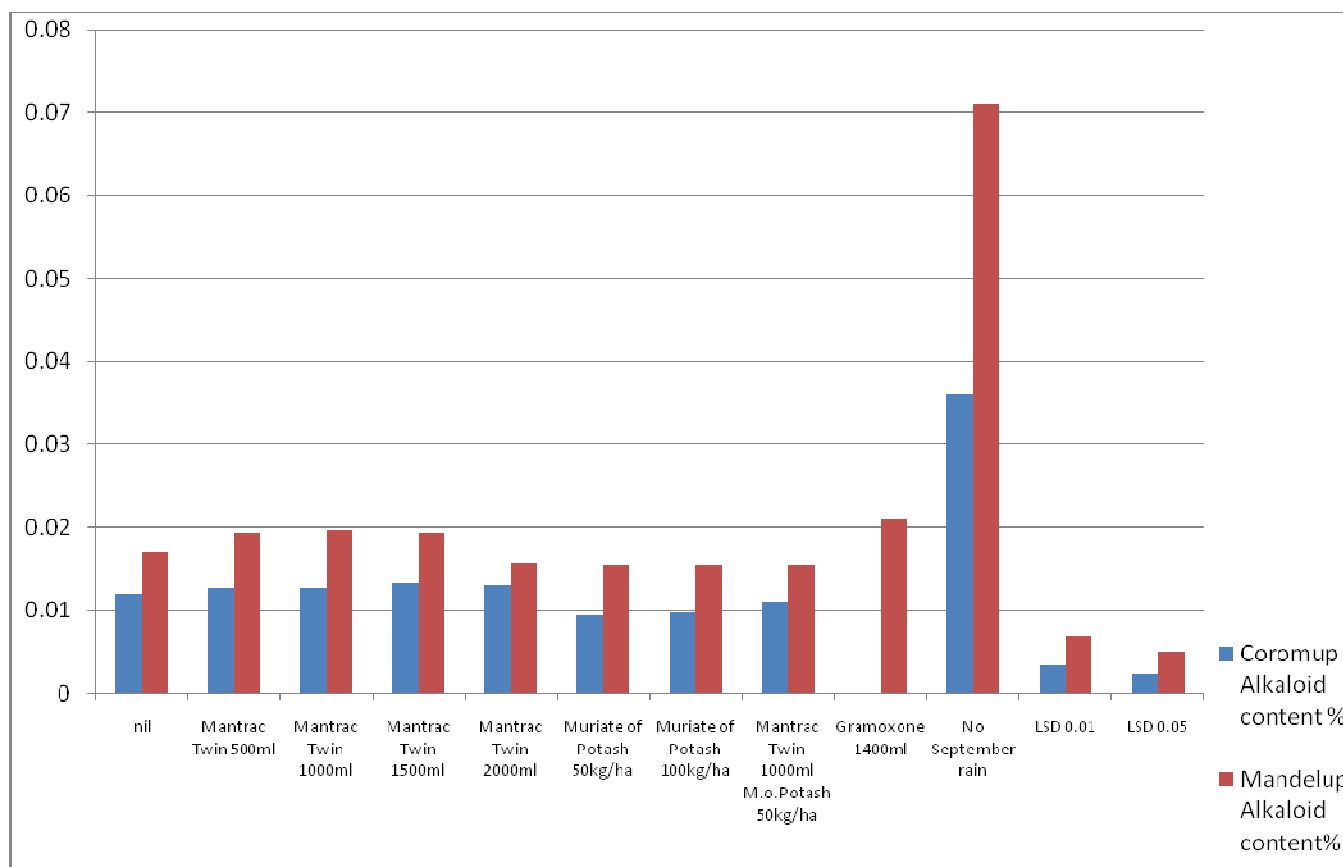


Figure 2: Alkaloid Content of Coromup and Mandelup Lupins



Discussion:

Coromup Lupins

Manganese sprays appears to have increased alkaloid % although not significantly different to the untreated at the 5% LSD level. Muriate of Potash at the 50 kg/ha rates had significantly lower alkaloid levels than the Manganese spray treatments.

Muriate of Potash at the 50 kg/ha rates had significantly lower alkaloid levels than the untreated control. The 100kg/ha treatment was very close to being significantly different at 5%LSD.

The simulated dry finish with the rain exclusion shelter increased alkaloid levels to 3 times that of the untreated, which was significant. As the construction of the rain shelters was tedious and time consuming, this was not replicated but was done over an area that would have been equivalent to 3 plots. The addition of Potash to the Mantrac 1000ml treatment also reduced the alkaloid levels, and was very close to being significantly different to the 1500ml Mantrac treatment.



Discussion Cont'd:

Mandelup Lupins

The gramoxone treatment increased alkaloid levels, (not significantly) over the untreated control, but significantly over the Potash treatments at the LSD5% level.

Again, there was a noticeable trend that the addition of Potash reduced the Alkaloid content of the Mandelup lupin seed. Manganese sprays appeared to increase alkaloid levels, except for treatment 5 (2 litres/ha of Mantrac) which decreased alkaloid levels. As this appears inconsistent with the other treatments and the same treatments in the Coromup variety, this may be an anomaly or error in sampling or testing.

The rain exclusion treatment that prevented the crop accessing rainfall in September had increased alkaloid levels by over 4 fold in Mandelup lupins. As the construction of the rain shelters was tedious and time consuming, this was not replicated but was done over an area that would have been equivalent to 3 plots in each variety.

Conclusions:

The omission of rainfall in September had the greatest effect on seed size and alkaloid content of both varieties. The trial data shows a significant reduction in alkaloid content compared to the untreated plots where additional Potassium was applied in the Coromup variety. This effect was less noticeable and not significant (0.05) in the Mandelup variety. Manganese sprays caused significantly higher levels of alkaloids than the Potassium treatments in the Coromup lupins. This effect was slightly less in the Mandelup lupins and was not statistically significant.

Croptopping the Mandelup variety also significantly increased the alkaloid content over the untreated, and also elevated the levels over the 0.02% safety threshold for human consumption.

Future Management Recommendations for lupins for Human Consumption –

1. Use the Coromup variety where possible
2. Plant as early as possible to avoid dry finishes and reduced grain filling from drought stress
3. Avoid croptopping - this treatment increased alkaloids over the human consumption limit
4. Avoid Manganese sprays if possible, there was a trend of increased alkaloid levels when Mn was sprayed onto the crop
5. Maintain adequate to luxury levels of Potassium – even though it did not increase yield, additional Potassium did reduce alkaloid levels compared to the untreated plot that only received the farmer basal fertiliser prior to sowing.



Research conducted by Grant Thompson for the Irwin Valley Group