The value of organic nitrogen from lupins

Alan Meldrum, Pulse Australia

KEY MESSAGES

- Modern lupin cultivars contribute a rotational benefit to wheat production.
- Wheat following lupin yielded 13% more than wheat following wheat.
- Residual N from lupins delivered a consistent 1% gain in wheat protein across all N rates.

BACKGROUND

Lupin production has declined in WA in recent years because of low commodity prices and drought. Growers' attention has also been focussed on annual cash returns from grain crops. The rapid rise in the price of nitrogenous fertiliser in 2008 renewed interest in lupin production, and the rotational benefits to the following cereal crop.

Previous research has established a good rule of thumb for residual N from lupins. However, modern varieties may provide less residual N than older varieties if they produce higher yields.

A trial to determine the value of residual N from a modern lupin cultivar was attempted at four sites in 2007. Trials at Mingenew with MIG collaboration, and Marchagee with Liebe Group collaboration, failed in 2007 due to drought. The site at south Yealering, in collaboration with the Facey Group, produced a large variation in wheat yield across the site in 2008 with no significant result. This was possibly due to the very dry August and September. The trial conducted at Wongan Hills is reported here.

AIMS

To determine if Mandelup lupin, a high yielding modern variety, provides similar rotational benefits as found by previous research with older varieties.

METHOD

In 2007 four treatments were applied to lupins (cv Mandelup) to deliver varying amounts of residual nitrogen. One wheat variety was sown for the wheat on wheat comparison (cv Carnamah).

In 2006 the paddock was cropped to wheat. For the three years prior, 2005, 2004 and 2003, the paddock had a grassy volunteer pasture with low legume content.

Table 1 **Treatment table for lupins sown in 2007**

Treatment	Anticipated N residue	Sowing date
Lupins sown early and harvested	Normal expected level of residual N	28 May 2007
Lupins sown late and harvested	Less than normal level of expected residual N	15 June 2007
Lupins brown manured at first pod development	Higher than expected residual N	28 May 2007
Lupins brown manured and slashed to enhance N mineralisation	Much higher than expected residual N	28 May 2007
Wheat	No residual N	31 May 2007

In 2008, 3 rates of nitrogen were applied across the 2007 plots to wheat (cv Carnamah). The nitrogen rates were 0, 25 and 50 units of N delivered as Flexi-N immediately prior to sowing.

The biomass and grain yields were measured in 2007, while wheat yields and grain quality were measured in 2008.

RESULTS

2007

Lupins (cv Mandelup) were established at two dates: 28 May and 15 June. Wheat (cv Carnamah) was established 31 May. The trial site was weed free for the entire season.

The later lupin sowing performed better due to low moisture during establishment for the early sowing. Despite this, plant numbers were similar for both. A favourable spring enabled the later sown lupins to yield better.

Brown manuring was conducted on 19 September using 2 L/ha of glyphosate.

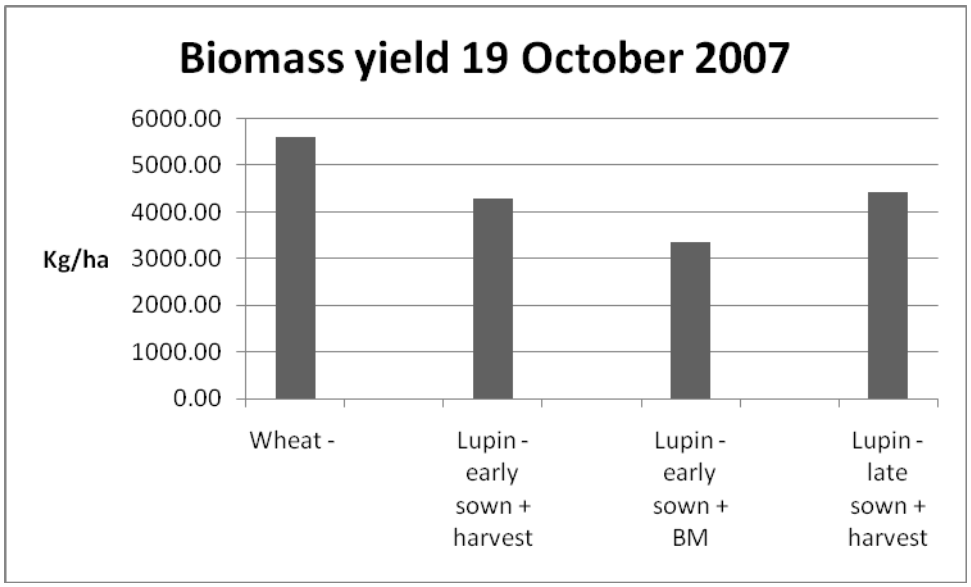

Figure 1 2007 biomass yields.

The 2007 yields were acceptable in a difficult season. No measurements were taken of residual soil moisture from the brown manuring treatments.

Table 2 **Biomass and grain yield results from 2007**

	Treatments	Biomass	Yield
Lupin	early sown + harvest	4285	1.58
Lupin	late sown + harvest	4442	1.70
Lupin	early sown + Brown manure	3360	0.00
Lupin	early sown + BM + Slash	-	0.00
Wheat	district practice	5600	2.73

Soil test data showed an increase in Nitrate nitrogen from the brown manure treatments but no increase from the harvest treatments over the level in wheat stubble.

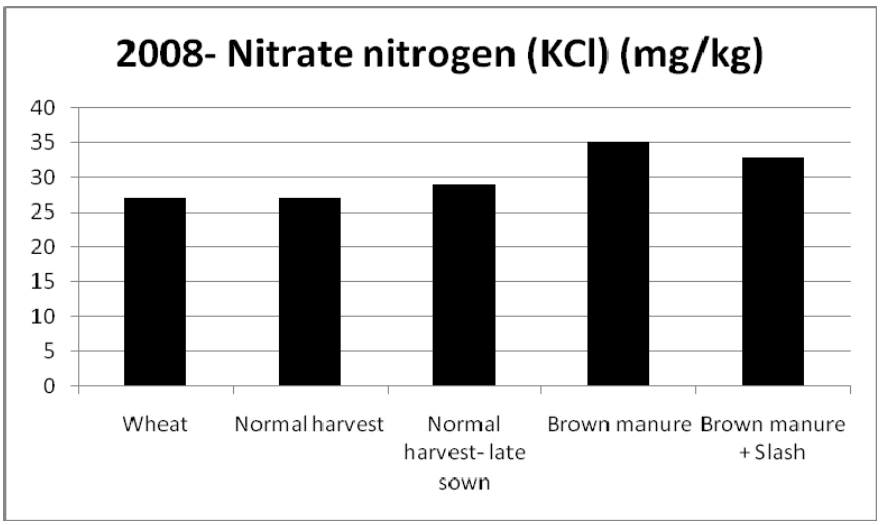

Figure 2 Soil Nitrate levels, April 2008.

2008 Wheat yield

Carnamah was planted on 12 June 2008. The nitrogen rates were applied as Flex-N IBS at right angles over the 2007 treatments with two replications within each replication from 2007.

Table 3 **Yield results from 2008**

		2008 N rates		
2007 treatments		**nil N**	**25 units N**	**50 units N**
Lupin	early sown + harvest	3.01	3.16	3.18
Lupin	late sown + harvest	3.22	3.27	3.24
Lupin	early sown + Brown manure	3.14	3.34	3.34
Lupin	early sown + BM + Slash	3.01	3.42	3.25
Wheat	district practice	2.63	2.84	2.77
Response to applied N in 2008 – l.s.d. 5%			0.08	
Response by wheat to 2007 treatments – l.s.d. 5%			0.25	
Response to applied N and 2007 trmts – l.s.d. 5%			0.34	

The response of wheat to applied N in 2008 was highly significant across most treatments. The response of wheat following lupins was highly significant irrespective of lupin treatment.

There were few significant interactions between residual N levels and applied N. There is a trend of decreased wheat yield in treatments with high levels of residual N.

2008 Grain protein—analysis by Australian Grain Centre

Table 4 **Wheat protein analysis from 2008**

		2008 treatments		
2007 treatments		**0 units N**	**25 units N**	**50 units N**
Lupin	early sown + harvest	10.8	11.4	12.2
Lupin	late sown + harvest	11.1	11.3	12.4
Lupin	early sown + Brown manure	11.9	12.5	13.4
Lupin	early sown + BM + Slash	12.0	12.4	13.3
Wheat	district practice	9.8	10.2	11.2
	l.s.d. @ 5%		0.5	

Wheat protein was higher in all treatments following lupins than following wheat.

Twenty-five units of N on wheat following wheat produced less protein than 0 N after lupins. Protein increased for all treatments where yield declined, showing that yield potential for this situation was attained. Applied N was able to lift wheat protein after wheat to above the 10% requirement for the APW grade.

CONCLUSION

The response to applied N by wheat was similar regardless of the previous crop or treatments, indicating that lupins at this site have delivered a yield increase which may be due to factors other than the residual N. This is possibly due to root disease suppression by the 2007 lupins. The very dry August and September would have suppressed any significant leaf disease incidence. The paddock history indicates a potential for cereal root disease which would have been adequately reduced by the lupins in 2007.

The background Nitrate status of the paddock may have suppressed the potential response to applied N. Significantly, lupins raised wheat protein in the following crop by 1%, as shown in Table 4.

It is also possible that wheat in 2008 could have responded to residual soil moisture from the brown manuring treatments. A trend to increased yield is apparent at 25 units of N, with increased protein at 50 units of N.

Early maturing varieties of lupins can attain acceptable yields from later sowings given favourable spring conditions, as shown in Table 2.

Continued yield benefit is expected from the lupin residual N as this continues to mineralise over the next two seasons.

KEY WORDS

lupins, nitrogen, wheat, yield, protein

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