GOA Site Report

Phosphorous placement and its effect on establishment of lupins

Trail Code: GONU00917-2

Season: Winter, 2017

Location: 'Inglewood' Gilgandra

Collaborators: Tex Kilby

Keywords

GONU009, Lupins, phosphorus placement, phosphorus response, Gilgandra

Take home messages:

Placement of fertilizer away from seed did not affect crop establishment, however in dry seasons surface applications may limit its availability.

Lupins may have a small yield response to phosphorous in soils with moderate levels of P.

Placement of starter fertiliser below the seed is sound practise, if possible, particularly if a drier season is forecast.

Background

Phosphorus (P), while an important nutrient for lupin production, is generally not considered a major limiting factor as lupins are relatively efficient in extracting soil P. Some research, however, has found yield responses to P application of P. There is also some evidence suggesting that higher P rates can adversely affect lupin germination, particularly on drier soils[1]. This therefore, queries is P yield response masked by germination limitations? Research by Scott et al. 2003[2] looked into responses to P with various placement (below seed, with seed and above seed) in Southern NSW. They found banding P below seed resulted in slightly enhanced yields. The trial used row spacing of 17 cm and there was some speculation that a wider row spacing (with subsequent increase in P applied with seed) may have a greater adverse impact on germination.

P is generally applied at planting with seed, and in zero tillage farming this is generally considered to be almost the only opportunity for introducing it into the system. Anecdotal evidence suggests that this practice may negatively influenced lupin establishment.

Trials referred to above tend to indicate the importance of P application at planting on crop yield. The unanswered question is 'would yields be improved if P could be applied early or in a better location

[1] Lupin Growth and Development, NSW DPI, 2011

[2] Scott BJ, Carpenter DJ, Braysher BD, Cullis BR, Evans CM, 2003. Phosphorus fertiliser placement for lupins in southern NSW. Australian Journal of Experimental Agriculture 43(1), 79–86.

(in relation to seed) to minimise adverse impact on plant germination?' As P is relatively immobile in the soil it is reasonable to assume that P placed above the seed (i.e. incorporation by sowing) will not have a negative effect on germination, but may also not be available for uptake by germinating plants.

Aims

1. Determine effect on crop establishment of placement of P, either below, with or above (broadcast) seed
2. Determine the effect on yield of various P placement treatments

Methods

Treatments: To investigate influence of P placement and rate on germination and yields. Four P rates were applied (0, 5, 10 and 20 kg P/ha) in four locations relative to the seed; 1. 'below' in a band approximately 7-8 cm below the soil surface (4.5-5 cm below the seed), 2. 'with' seed, 3. 'IBS' - broadcast onto the soil surface and incorporated by sowing, and 'Post Plant' broadcast onto the soil surface post sowing. Full treatment list and results are provided in Annex 1. Untreated Control is where no phosphorous was applied (though had all the same cultural treatments).

The trial was established in Autumn 2017 and used a full factorial randomised complete block design with three replicates. Plot size was approximately 2 m wide and 10 m in length. The main details of the trial are outlined in Table 1.

Table 1. Trial site details

Trial Establishment Date	Autumn 2017		
Crop and Variety	Lupins - Albus	**Seeding rate**	100 kg/ha
Sowing date	28/4/2017	**Harvest Date**	10/11/2017
Seedling equipment	Double boot knife point press wheel	**Row Spacing**	27.5 cm
Crop Nutrition (kg/ha)	nil	**Soil type**	Sandy Clay Loam
Previous Crop	Wheat	**Pre-Sowing Stubble Management**	Standing stubble, narrow windrows burnt
Soil test results:			
Colwell P:	0-10 cm 30 ppm 0-30 cm 7 ppm	**Phosphorus** Buffering Index:	0-10 cm: 58 10-60 cm: 92

Results

Plant Establishment: Approximately 30 plants/m^2 were established across all treatments. Placement of P with seed did not reduce plant establishment when compared to where no phosphorous was applied, nor where it was applied below the seed or on the soil surface.

Yield: Average yield was ~0.8 tonnes/ha. Treatments where P was placed with or below the seed yielded better than where no P was applied. P placement below the seed (regardless of rate) improved lupin yields by about 100 kg/ha (**Figure 1**), while placement of P on the soil surface, either IBS or

broadcast post plant was not significantly better than not applying any P. Highest rate of P yielded about 100 kg/ha more than where no P was applied.

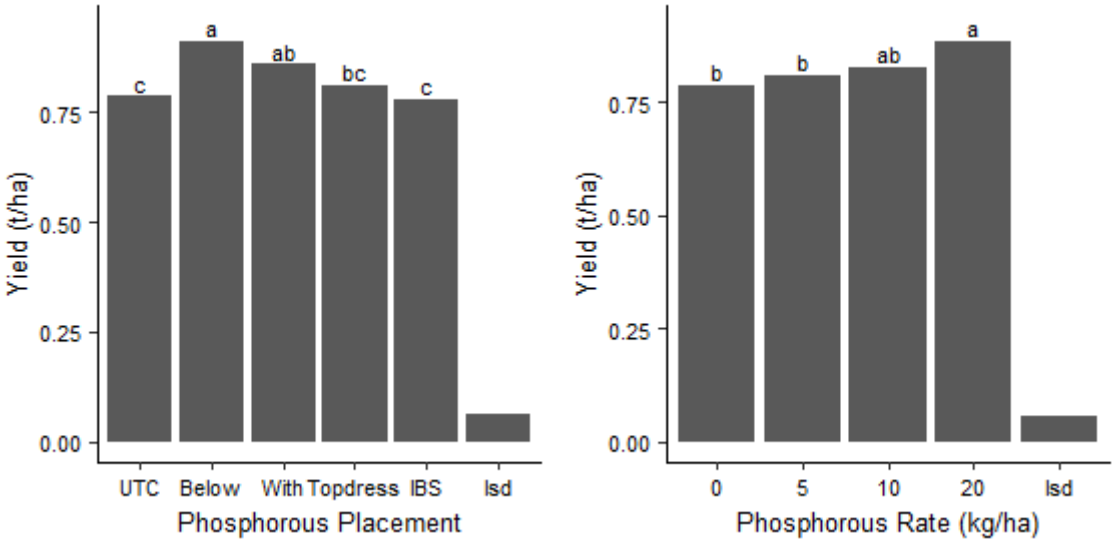

Figure 1. Lupin yields for the various seed placement options and phosphorous rates. UTC (or untreated control) had no added P. Data with the same letter are not significantly different.

Discussion

There was no reduction in plant establishment from placing P fertiliser with seed. Application of various P treatments was undertaken at sowing using a double boot system (DBS) and, ripped all treatments to a depth of 6-7 cm (~3-4 cm below the seed). All plots were treated the same to remove any 'ripping' effect. This may have resulted in a 'soft' or 'unconsolidated' landing for seed and any P placed with it. This therefore may not be a true reflection of a single tyne system where seed and fertiliser are essentially hitting the bottom of the furrow together. This may have reduced the impact of P on germination, particularly where P was placed 'with' seed.

There was also no adverse impacts on plant establishment by placement of P away from seed, either below, IBS or post plant.

There was a small yield response to both rate and placement of P, placement below seed yielded better than an IBS application, which in turn was not better than nil P. There was a modest yield response curve to increasing rates of P, however the difference between the highest and nil rates was in only 100 kg (**Figure 1**) (regardless of application method).

When looking at the interaction between rate and placement, only the 'below' treatment resulted in a yield increase, of about 200 kg/ha when compared to the UTC (**Figure 2**).

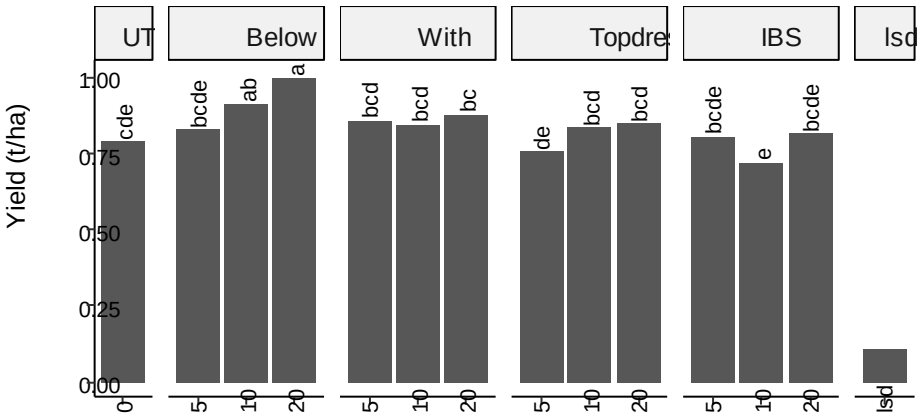

Figure 2. Lupin yields for the various seed placement options and phosphorous rates. Data with the same letter are not significantly different.

As 2017 was a very dry season it is likely that placement of P on the soil surface, either IBS or topdressed limited the plants access to it, while product placed under the seed was more available. Yield response for both rate and placement was small, and this is likely due to the low yields combined with moderate background soil P levels (Colwell P 0-10 cm of 30 ppm), equivalent of approximately 30 kg P/ha. more than sufficient for the estimated 3-4 kg P/t grain removal of this crop.

Conclusions

Placement of fertilizer away from seed did not affect crop establishment, however in dry seasons surface applications may limit its availability.

Lupins may have a small yield response to phosphorous in soils with moderate levels of P. Maintaining soil P for subsequent crop is sound strategy. If possible placement of starter fertiliser below the seed is sound practise, particularly if a drier season is forecast.

Acknowledgements

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Appendix

Table 2. Impact of P rates and P placement on plant establishment and yield of lupins. Results followed by the same letter are not significantly different.

P-rate (kg/ha)	P Placement	Yield (t/ha)		Plant Establishment Count (plants/m^2)	
0	Control	0.8	bc	32	ab
5	Below	0.8	bc	26	bc
5	IBS	0.8	bc	35	a
5	Post plant	0.8	bc	25	c
5	With	0.9	abc	34	ab
10	Below	1.0	a	33	abc
10	IBS	0.7	c	26	bc
10	Post plant	0.8	bc	35	a
10	With	0.8	bc	29	abc
20	Below	1.0	a	28	abc
20	IBS	0.8	bc	33	ab
20	Post plant	0.8	bc	26	bc
20	With	0.9	ab	30	abc
lsd	lsd	0.1		8	