

Phosphorous placement and its effect on establishment of lupins

Trail Code: GONU00916-1
Season: Winter, 2016
Location: 'The Plains', Nyngan
Collaborators: Haydon Wass

Keywords

GONU009, Lupins, phosphorus placement, phosphorus response, Nyngan

Take home messages:

Results from this trial suggest that plant establishment under optimal conditions is less effected by placement of P with the seed.

In wet seasons achieving a P response might be less likely in soils with moderate starting levels of P.

Background

Phosphorus (P), while an important nutrient for lupin production, is generally considered a less limiting factor as lupins are relatively efficient in extracting soil P. Some research, however, has found yield responses to P application and there is also some evidence suggesting that higher rates can adversely affect lupin germination, particularly on drier soils¹. This, therefore, begs the question is the yield response masked by germination limitations? Research by Scott et al. 2003² looked into responses to P with various placement (below seed, with seed and above seed) in Southern NSW. They found that banding P below the seed resulted in slightly enhanced yields. The trial used a row spacing of 17 cm and there was speculation that a wider row spacing (with subsequent increase in P applied with the seed) may have a greater adverse impact on germination.

P is generally applied at planting with seed, and in zero tillage farming this is the almost the only opportunity for placing it below the soil surface. Anecdotal evidence suggests that this practice may have negatively influenced crop establishment.

Trials referred to above tend to indicate the importance of P application at planting on crop yield. The question left unanswered is 'would yields be improved if P could be applied early or in a better location (in relation to the seed) to minimise impact on plant germination?' As P is relatively immobile in the soil it would be reasonable to assume that P placed above the seed (i.e. incorporation by sowing) will

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.

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

Methods

Treatments: To investigate the influence of P placement and rate on germination and yields, four rates were applied (0, 5, 10 and 20 kg P/ha) in four locations relative to the seed, below (in a band approximately 7-8 cm below the soil surface (4.5-5 cm below the seed)), with the seed, broadcast onto the soil surface and incorporated by sowing (IBS) and broadcast onto the soil surface post sowing. The full treatment list is shown in Annex 1.

The trial was established in Autumn 2016 and used a full factorial randomized complete block design with three replicates. Plot size was approximately 2 m wide and 10 m in length. Main details of the trial are outlined in Table 1.

Table 1. Trial site details

Trial Establishment Date	Autumn 2016		
Crop and Variety	Lupins - Albus	Seeding rate	100 kg/ha
Sowing date	6/5/2016	Harvest Date	5/12/2016
Seedling equipment	Double Boot Tyne	Row Spacing	27.5 cm
Crop Nutrition (kg/ha)	nil	Soil type	Sandy Clay Loam
Previous Crop	Wheat	Pre-Sowing Stubble Management	Burnt pre-sowing
Soil test results:			
Colwell P:	0-10 cm 31 ppm 0-60 cm 7 ppm	Phosphorus Buffering Index:	0-10 cm: 47 10-60 cm: 62

Results

Plant Establishment: Approximately 32 plants/m² were established across all treatments, slightly lower than the target of 35 plants/m². Placement of P with the seed (or any of the other placement options) did not reduce plant establishment when compared to no added P.

Yield: Average yield was 3.9 tonnes/ha. There was no statistically significant impact on yield for any of the treatments.

Discussion

The application of the various P treatments was undertaken at sowing. The DBS system used in this instance ripped to a depth of about 8 cm (~5 cm below the seed) for all treatments. This action would have resulted in a 'soft' or 'unconsolidated' landing for the seed and any P placed with it. This may not

be a true reflection of a normal tyne seeding system where seed and fertiliser are essentially hitting the bottom of the furrow together. As such, this may have reduced the impact of P on germination, particularly where P was placed 'with' the seed.

This mixing of the soil may have attributed to lack of treatment effect of P placement with seed. It is also possible that other factors such as rainfall (30 mm fell 2 days after planting) and favourable soil temperatures contributed to lack of effect.

There was also no adverse impacts on plant establishment by placement of P away from seed.

This lupin crop achieved very high yields, close to 4 t/ha. P removal in grain would be in around 15 kg/ha³. Soil testing indicated moderate P levels (Colwell P 0-10 cm of 31 ppm, equivalent of over 40 kg P/ha). This, in combination with the wet season (475mm in-crop rainfall ⁴), is likely to account for lack of P response.

Conclusion

The impact of placement of starter P fertilisers with Lupin seed on establishment under optimal conditions is minimal.

In wet seasons achieving a P response might be less likely in soils with moderate starting P levels.

Acknowledgements

The research undertaken as part of this project is made possible by the significant contributions of growers through both trial co-operation and support of GRDC. The authors would like to thank them for their continued support. Special thanks to the Wass family who hosted this trial.

³ Albus Lupins extract ~3.6 kg P/tonne of seed, GRDC Grow Notes, Lupins, Northern Region. 2018, GRDC

⁴ APSIM station number = 051118, station name = NYNGAN (THE PLAINS)

Appendix

Annex 1. Treatments and results

P Rate (kg/ha)	P Placement	Yield (t/ha)	Plant Est Count (plants/m ²)
0	Below	4.1	31.8
0	IBS	3.8	33.5
0	Post plant	3.9	35.5
0	With	3.9	32.0
5	Below	3.7	33.0
5	IBS	3.6	30.6
5	Post plant	4.1	30.2
5	With	3.5	36.7
10	Below	3.9	32.4
10	IBS	3.9	33.5
10	Post plant	3.9	28.8
10	With	3.9	31.2
20	Below	3.8	32.6
20	IBS	3.7	34.7
20	Post plant	4.0	32.2
20	With	3.9	26.8