# GOA Site Report

## Phosphorous placement and its effect on establishment of lupins

**Trail Code:** GONU00916-2

**Season:** Winter 2016

**Location:** 'Methalibar', Warren

**Collaborators:** Mal McKay and the McKay family


## Keywords

GONU009, Lupins, phosphorus placement, phosphorus response, Warren


## Take home messages:

Placement of starter P fertilizer with seed did not affect establishment at the lower rates however caution is advisable if using higher rates.

Where P levels are moderate or better a response to additional phosphorous in lupins is unlikely.

## 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 and there is also some evidence suggesting higher rates can adversely affect lupin germination, particularly on drier soils[1]. This therefore, begs the question is the yield response masked by germination limitations? Research by Scott et al. 2003[2] examined responses to P with various placement (below seed, with seed and above seed) in Southern NSW, and found that banding P below the seed resulted in slightly enhanced yields. The trial used row spacing of 17 cm and there was 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 lupin yield. The question unanswered is 'would yields be improved if P could be applied early or in a better location (in relation to the seed) to minimise possible adverse 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 not have a negative effect on germination, but may also not be available for uptake by germinating plants.

[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.

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## Aims

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

## Methods

**Treatments:** Investigate the influence of P placement and rate on germination and yields. Four rates of P 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 seed), with the seed, broadcast onto the soil surface and incorporated by sowing (IBS) and broadcast onto the soil surface post sowing. Full treatment list is shown in Annex 1.

The trial was established 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. Treatment 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** | 22/4/2016 | **Harvest Date** | 1/12/2016 |
| **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 48 ppm<br>10-60 cm 13 ppm | **Phosphorus** Buffering Index: | 0-10 cm: 63<br>10-60 cm: 82 |

## Results

**Plant Establishment:** Approximately 30 plants/$m^2$ were established on average across all treatments, slightly lower than the target of 35 plants/$m^2$. Placement of P with seed reduced plant emergence at the highest P rate (i.e. 20 kg P/ha) by 35% when compared to the 0 P treatment. No other treatment had a significantly adverse impact on germination (Figure 1).

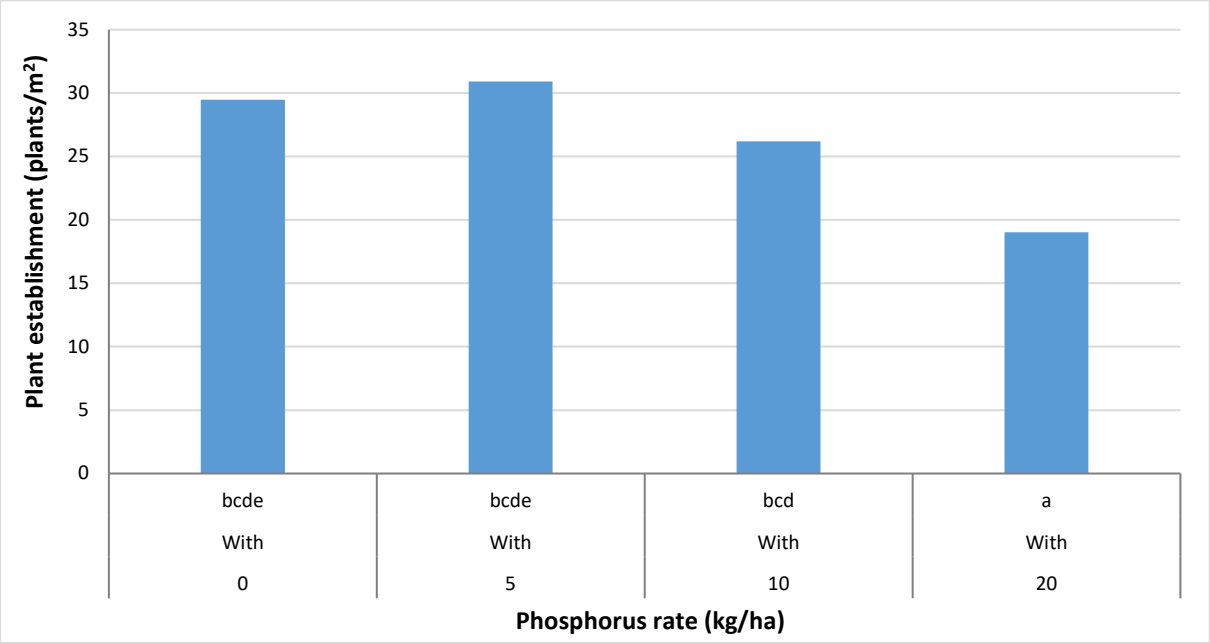


**Figure 1.** Plant establishment where four rates of P (kg/ha) was placed with the seed
*values with the same lettering are not significantly different from each other

**Yield:** Average yield was 2.0 t/ha. There was no impact of P placement on yield however there was some impact of rate, where yields tended to be lower at the higher applications of P. Interaction between placement and rate is limited to the 'Below' treatment (Figure 2).

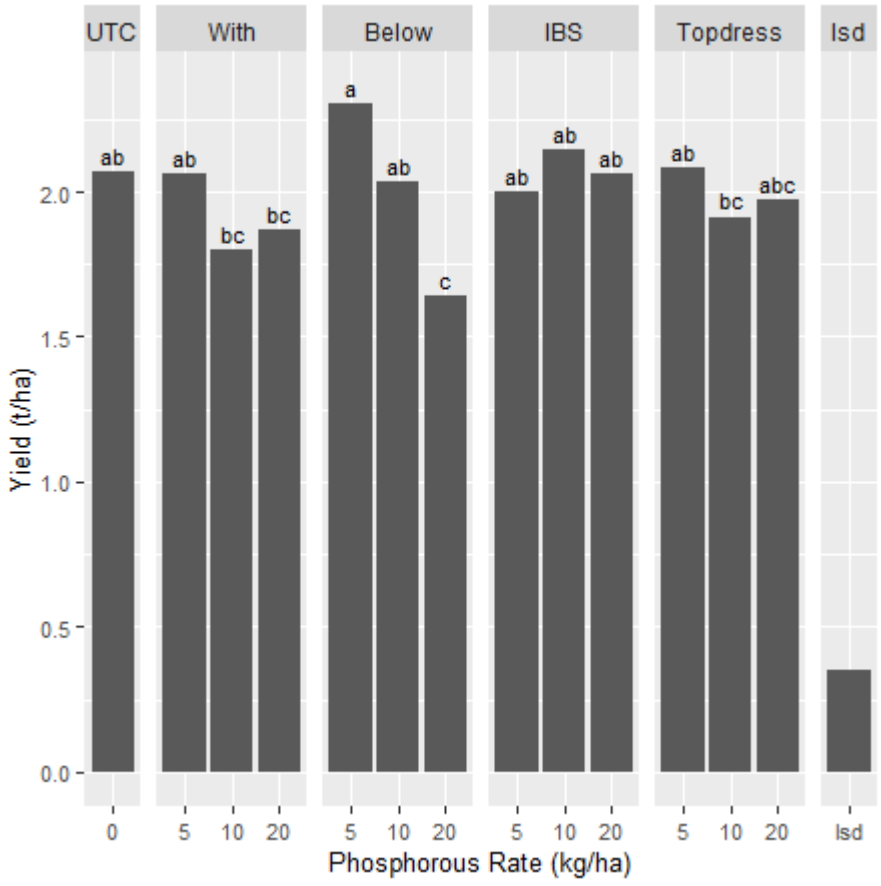


**Figure 2.** Yields (t/ha) for the three rates of P (kg/ha) and various placement options.
*values with the same lettering are not significantly different from each other

## Discussion

Application of the various P treatments was undertaken at sowing. The DBS system used ripped to a depth of about 8 cm (~5 cm below the seed) for all treatments. This 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 tyne seeding system where seed and fertiliser are essentially hitting the bottom of the furrow together. This may have reduced impact of P on germination, particularly where P was placed 'with' the seed.

However, the trial detected a negative impact on germination where P was placed with seed at the highest P rate, where establishment was reduced by about 35%. This effect did not carry through to harvest, as yield was significantly different to the untreated control. The only yield differences was where P was placed below the seed. A possible reason for this may be 'root pruning' as the plant grew through the band of phosphorous, however an assessment of vegetation index early in the season (data not reported) did not detect any differences in crop growth suggesting this is unlikely to be the cause.

Soil testing at this site indicated very strong[3] baseline levels of soil P (Colwell P 0-10 cm of 48 ppm, equivalent to about 60 kg P/ha). P removal in grain would be in around 7 kg/ha[4] hence background soil P would have been more than adequate to support a 2 t/ha crop.

## Conclusion

Placement of starter P fertilizer with seed did not affect establishment at the lower rates however caution is advisable if using higher rates.

Where P levels are better than moderate or better a response to additional phosphorous in lupins is unlikely.

## Acknowledgements

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

[3] GRDC GrowNotes – Lupin 2017

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

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**Annex 1.** Treatment list and results

| Phosphorous | | Plant establishment | | Yield | |
|---|---|---|---|---|---|
| **Rate (kg/ha)** | Placement | plants/m2 | | (t/ha) | |
| **0** | UTC | 29 | cd | 2.1 | ab |
| **5** | Below | 32 | abc | 2.3 | a |
| **5** | IBS | 31 | abc | 2.0 | ab |
| **5** | Topdress | 37 | a | 2.1 | ab |
| **5** | With | 31 | abc | 2.1 | ab |
| **10** | Below | 36 | ab | 2.0 | ab |
| **10** | IBS | 32 | abc | 2.1 | ab |
| **10** | Topdress | 28 | bd | 1.9 | bc |
| **10** | With | 27 | cde | 1.8 | bc |
| **20** | Below | 26 | cde | 1.6 | c |
| **20** | IBS | 33 | abc | 2.1 | ab |
| **20** | Topdress | 27 | cd | 2.0 | abc |
| **20** | With | 19 | e | 1.9 | bc |
| **lsd** | lsd | 8 | | 0.3 | |