# GOA Trial Site Report

## Phosphorous placement and its effect on establishment and performance of canola

**Trail Code:** GONU00617-2

**Season/year:** Winter 2017

**Location:** Gilgandra

**Collaborators:** Kevin and John Kilby


## Keywords

GONU006, phosphorus, deep banding, IBS, canola, germination, establishment, P rate, Gilgandra


## Take home messages

In soils testing low for phosphorus (P), canola is likely to show a yield response to added P fertiliser

While not necessarily reflected in this trial, placement of P with seed can adversely impact on germination, even at lower P rates. Where possible consider alternative P placement or compensate by adjusting seeding rate.

In dry seasonal conditions, placement of P below the seed is likely to provide greater benefit, followed by P placement with seed.

Given that in this far drier than normal year, there was a yield response, albeit small, to surface applied P. The option to broadcast P ahead of sowing warrants more testing.

## Background

Phosphorus (P) is an important nutrient in canola production at two key stages; establishment to support root development and during biomass accumulation.

Traditionally, P has mainly been applied at planting and often is banded in close proximity to seed. This approach is based on P being relatively immobile in the soil and needs to be placed close to the developing canola root system.

Damage to crop establishment by placing fertiliser P close to seed has long been accepted. For example, trials conducted in 2013 by NSW Department of Primary Industries[1] found significant reductions in canola establishment with increasing rates of P (up to 20 kg/ha). Yields also increased with increasing P rates despite emergence suppression. A consequence of establishment suppression is the unpredictability and variability of damage, which can make targeting an ideal seeding rate difficult. If effect on establishment is high, very poor stands can eventuate and they may be unable to adequately compensate for low plant numbers. Yield may be adversely affected. Nonetheless, increasing seeding rate can compensate for these losses, though this comes at a cost.

The dilemma, therefore, is that canola crops mainly require fertiliser P for optimise yields, however, placing P with seed can lead to significant problems. NSW DPI trials referenced above did not investigate alternate placement options for applying P to canola.

[1] https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2014/02/Canola-agronomy-research-in-central-west-NSW

Many modern seeders have the ability to band fertiliser below the seed. There is also the option with any sowing equipment to broadcast P either pre or post seeding. This trial is designed to investigate if application of P using alternate methods could avoid damage at establishment while maintaining a positive P fertiliser response.

## Aims

Determine if varying P placement and the rate of P fertiliser can reduce negative impacts on crop establishment and yield, while maintaining canola P responsiveness.

## Methods

The trial was a small plot, full factorial randomised complete block design with three replicates established in autumn 2017.

The trial looked at rate of P applied and the effect of P placement on canola germination and yield. All combinations of placement and P rates were able to be assessed by the trial design.

- **Rates:** Three rates of P in the form of triple superphosphate (Trifos) were applied at 0, 15, 30 and 45 kg/ha of P
- **Placement:** P fertiliser was applied by three methods-
  - Below the seed - in a band approximately 6 cm below the soil surface and 4 cm directly below the seed, applied in the same pass
  - With the seed - banded with the seed in the same pass
  - incorporated by the seeder (IBS) - Broadcast onto the soil surface prior to seeding
  - Broadcast - on the soil surface post planting with no incorporation

**Table 1.** Trial site details

| | | | |
|---|---|---|---|
| **Trial Establishment Date** | Autumn 2017 | **Seeding rate** | 2.5 kg/ha |
| **Crop and Variety** | Canola – BONITO | **Harvest Date** | 23/11/2017 |
| **Sowing date** | 27/4/2017 | **Row Spacing** | 27.5 cm |
| **Seedling equipment** | Knife point/press wheel | **Soil type** | Sandy Clay Loam |
| **Nitrogen Crop Nutrition Urea (kg/ha)** | 220 IBS | **Previous Crop** | Wheat |
| **Site Nutrition: Colwell P** | 0-10 cm: 21 ppm<br>10-30 cm: 8 ppm | **Pre-Sowing Stubble Management** | Burnt stubble |

Results were analysed using ANOVA for the analysis of variance and results compared by using a least significant difference (LSD) method with a 95% confidence interval. Any references to differences between treatments should be assumed to be statistically different unless otherwise stated.

## Results

Table with full results are contained in Appendix 1 at the end of the document.

**Plant Establishment:** At this site the average population was 33 plants/$m^2$. The placement of P with the seed did not significantly reduce the plant establishment, neither was there a negative impact of increasing phosphorus rates.

**Yields:** P treatments yielded 0.3 – 0.5 t/ha greater than nil P. However, P response tended to plateau where 30 kg P/ha and above were applied (**Figure 1**).

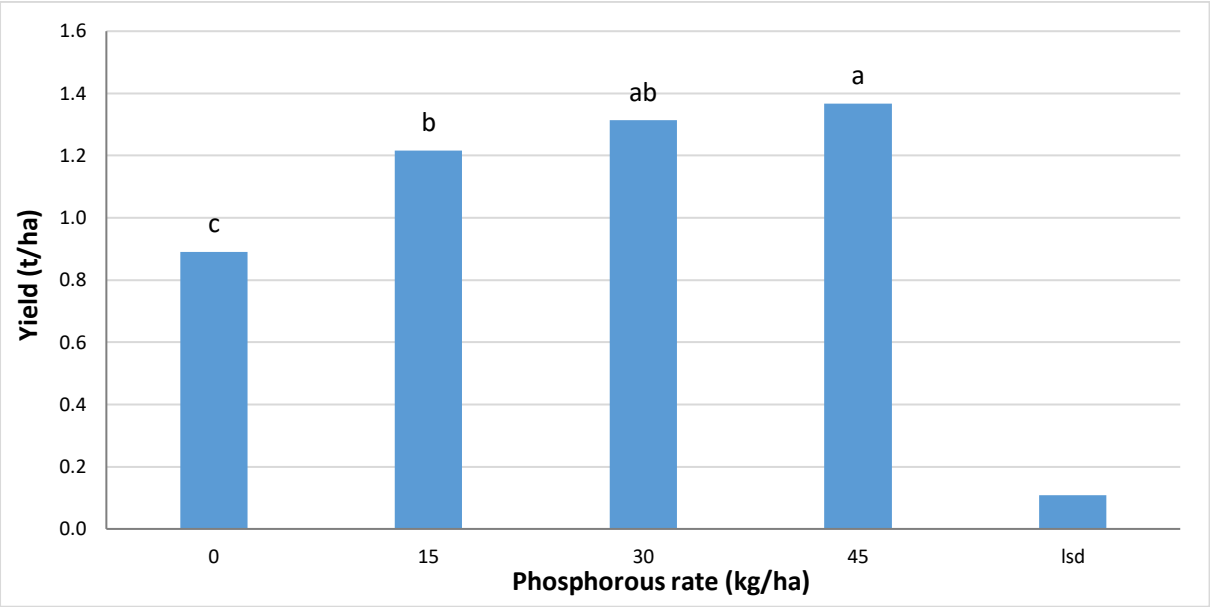


**Figure 1.** Yields (t/ha) for the four phosphorous application rates (regardless of placement).

There was a yield advantage of 0.6 t/ha by placing P below the seed at sowing when compared to nil P (**Figure 2**). Where P was applied with seed or broadcast post sowing a modest yield increase of 0.4 t/ha occurred. The lowest response was where P was broadcast pre sowing and IBS, where a 0.2 t/ha response was recorded.

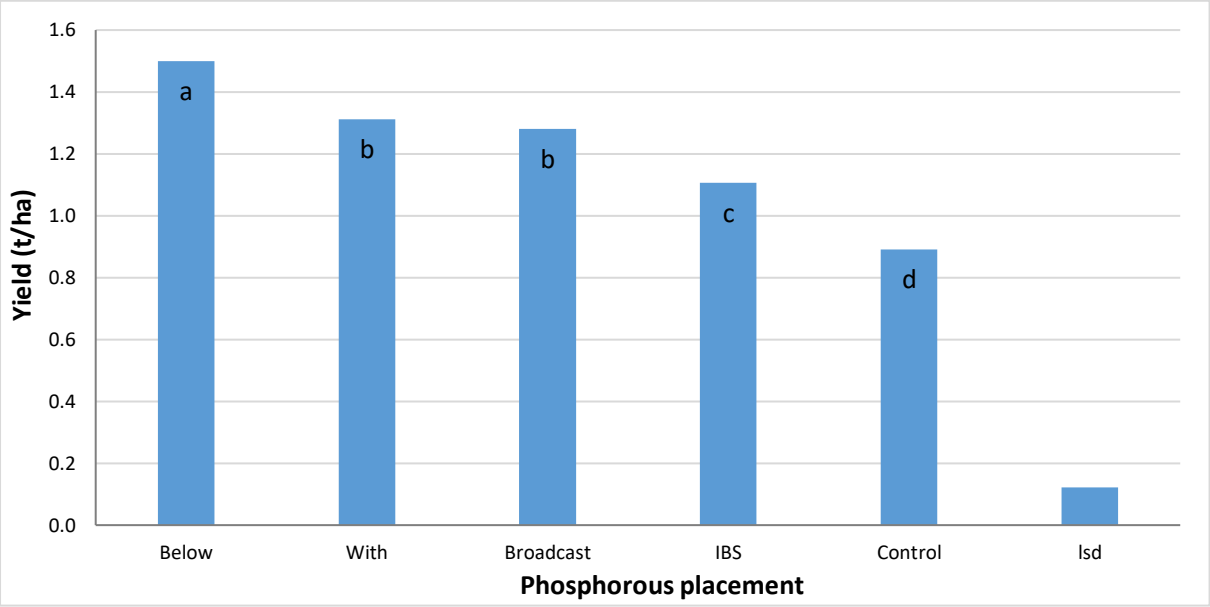


**Figure 2.** Yields (t/ha) for the four placement options regardless of rate. Below and With seed refer to the placement of P in relation to the seed and IBS is incorporated by sowing). Control is where no phosphorous was applied.

There was a similar response to P rate regardless of placement (**Figure 3**). There was no interaction between various P placement strategies and P rate, i.e. there was a similar response to placement regardless of the rate, and vice versa.

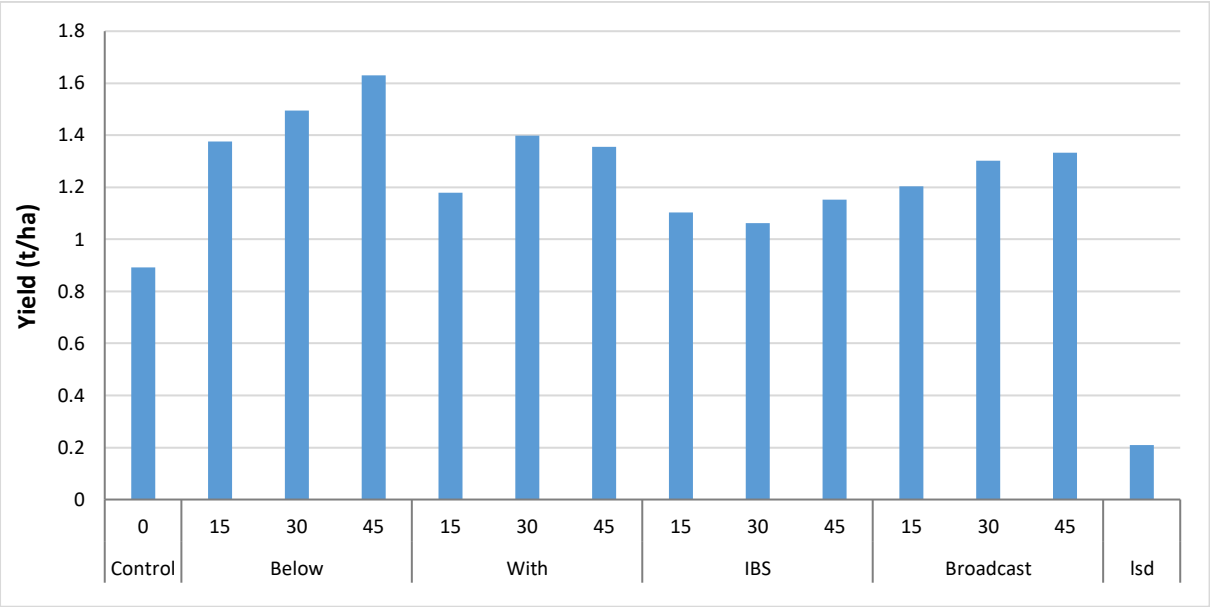


**Figure 3.** Yields (t/ha) comparisons of the various placement options and 4 application rates. Control is where no Phosphorous was applied.

**Oil %:** There was no influence of P rate or placement on oil content.

## Discussion

This site had moderately low soil P levels. Colwell P of less than 21 ppm in the surface 10 cm layer and 8 ppm in the 10 – 30 cm soil layer. This level of background P allowed for a significant yield responses to both P rate and placement.

There was no impact on plant establishment by P placement with seed. It is possible that the degree of disturbance of the Deep Blade Sowing (DBS) system used on all treatments caused enough soil disturbance to minimise seed fertilizer contact, minimising any establishment effects.

Both surface applications (broadcast and IBS) resulted in a yield response compared to control (nil P), indicating that there was some surface root activity and/or some P movement into the soil, even in a dry season. The lower yield response for IBS may be due to the sowing process, which may have dislodged fertiliser P away from the seed row.

P placement with seed has been the main method of application for many farmers in the GOA region. This trial found P with seed was no better option than broadcasting P post sowing.

Placement of P below the seed was by far the best treatment. It is possible that deeper placement (4-6 cm below the seed) placed fertiliser into soil where moisture was available to the plant for a longer period, particularly early in the growing season, and hence allowed a longer access to fertiliser P. It would be worth assessing if even deeper application would allow for further yield gains. It is also plausible that having P evenly distributed in the surface 5-10cm may also give yield improvements (as opposed to being banded or placed on the soil surface). At this site (and in this season) optimal P rate for maximising production was about 30 kg/ha, however, this may not necessarily reflect the optimal economic return.

Given the P response to broadcasting and that farmers are predominantly set up to apply P with seed, investigation into 'split' applications is warranted, as this may result in a reduction of impact on canola establishment, an improving logistics at sowing and possibly higher crop yields.

## Conclusion

In soils with low starting P, canola is likely to show a yield response to added P fertiliser.

While not necessarily reflected in this trial, placement of P with seed can adversely impact germination, even at lower P rates. Where possible growers should consider alternative placement or compensate by adjusting seeding rate.

In dry seasons, placement of P below the seed is likely to provide most benefit, followed by placement with seed (though take note of comment above).

Given that there was a yield response to surface applied P, albeit small, even in very dry conditions, the option to split applications between P broadcast ahead of sowing and P at sowing warrants more testing.

## 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 Kevin and John Kilby, Gilgandra, who hosted this trial.

## Appendix

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

| P-rate (kg/ha) | P Placement | Yield (t/ha) | | Plant Establishment Count (plants/m$^2$) | | Oil % | |
|---|---|---|---|---|---|---|---|
| **15** | Below | 1.38 | bcd | 33.7 | ns | 41 | ns |
| **30** | Below | 1.49 | ab | 37.1 | ns | 42 | ns |
| **45** | Below | 1.63 | a | 34.3 | ns | 42.1 | ns |
| **15** | Broadcast | 1.2 | cdefg | 38.7 | ns | 42.4 | ns |
| **30** | Broadcast | 1.3 | bcdef | 37.1 | ns | 42.1 | ns |
| **45** | Broadcast | 1.33 | bcde | 31.8 | ns | 41.9 | ns |
| **0** | Control | 0.89 | h | 38.1 | ns | 42.1 | ns |
| **15** | IBS | 1.1 | fg | 38.7 | ns | 42.2 | ns |
| **30** | IBS | 1.06 | g | 41.2 | ns | 41.9 | ns |
| **45** | IBS | 1.15 | efg | 38.1 | ns | 42.2 | ns |
| **15** | With | 1.18 | defg | 35.9 | ns | 41.6 | ns |
| **30** | With | 1.4 | bc | 36.1 | ns | 42.5 | ns |
| **45** | With | 1.36 | bcde | 32 | ns | 41.5 | ns |
| | lsd | 0.21 | | | | | |