# GOA Trial Report

## Canola nutrition – Fine tuning sulfur and nitrogen application rates

**Trail code:** GONU00115-2

**Year:** Winter 2015

**Location:** 'Kurrajong Park' 20 km N of Coolah

**Collaborators**: Paspaley Farms and Andrew McFadyen

### Keywords

Canola, nutrition, sulfur, response, nitrogen, yields, timing

### Key findings

- It was more profitable to apply nitrogen (N) than to apply sulfur (S).
- Canola was highly yield responsive to N.
- There was no response to applied S in yield or oil content.
- Timing of N had little impact on yield, however, earlier applications trended towards higher oil content.
- Oil percentages decreased as N rates increased.
- Higher N did not negatively impact on yield.
- There was no evidence that high and low biomass genotypes behave differently under higher N strategies.

### Background

Grain Orana Alliance (GOA) has been investigating the influence of nutrition on canola performance since 2010. Initial research focusing on S, suspecting fertiliser type and application timing may have been influenced oil content and be essential for maximising yields.

Two years of trial work in 2010 and 2011, specifically targeting low S sites, failed to find any S response for either yield or oil percentage (%). But in most cases, canola showed significant yield responses to increasing N fertiliser rates.

Subsequent GOA research from 2013 to 2016 has focussed on fine tuning N management to maximise yields and profits. These trials also aimed to investigate if the negative impact on oil % could be minimised by manipulating N timing and rates. These trials also continued to test for responses to applied S.

### Aim

- Demonstrate canola's responsiveness to N and identify parameters to predict the most economically appropriate rate of N fertiliser.
- Investigate if varying application of N timings influences both yield and/or oil performance.

- Explore any varietal response differences (biomass potential or bulkiness) to N rate and timing.
- Continue to investigate any canola responsiveness to S.

## Methods

Small plot, randomised design, 4 replicates.

- Two varieties of contrasting plant types:
  - high potential plant biomass at maturity (44Y84)
  - low biomass line (43C80).
- Five N rates; 0, 50, 100, 150 and 200 kg/ha N, applied as urea.
- Three N application timings:
  - sowing
  - budding
  - split application (half the N at sowing and the balance at budding).
- Sulfur, applied as granular gypsum, at nil or 20 kg/ha (drilled below the seed for all combinations of variety, N rate and timings).

Deep and shallow soil tests were taken at sowing to establish base level nutrition (see Table 2).

Yields were assessed by plot header and grain tested for quality parameters.

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 statistically different unless otherwise stated.

Table 1. Trial site details

| | | | |
|---|---|---|---|
| Trial establishment date | Autumn, 2015 | | |
| Variety | 44Y84 and 43C80 | Seeding rate | Target 45 plants/$m^2$ |
| Sowing date | 30/4/2015 | Harvest date | 9/11/2015 |
| Seedling equipment | Double boot tyne | Row spacing | 27.5 cm |
| Crop nutrition (kg/ha) | 100 kg/ha Triphos | Soil type | Clay loam |
| Previous crop | Wheat | Pre sowing stubble Management | Burnt |

Table 2. Soil test results at sowing [1]

| Analyte/Assay | Soil depth (cm) 0-10 | 10-30 | 30-60 | 60-90 |
|---|---|---|---|---|
| Organic carbon (%) | 1.1 | 0.6 | 0.4 | 0.2 |
| Nitrate N (mg/kg) | 7 | 2 | 1 | <1 |
| Ammonium N (mg/kg) | 1 | 1 | 1 | 1 |
| Phosphorus (Colwell) (mg/kg) | 11 | <5 | <5 | <5 |
| Phosphorus Buffer Index (PBI-Col) | 69 | 120 | 110 | 71 |
| Sulphate Sulphur (KCl40) (mg/kg) | 4 | 2 | 2 | 3 |

**Table 3.** 2015 Rainfall[2]

| Jan | Feb | Mar | April | May | June | July | Aug | Sept | Oct |
|---|---|---|---|---|---|---|---|---|---|
| 145 | 67 | 5 | 22 | 73 | 95 | 69 | 49 | 169 | 117 |

## Results and discussion

Full yield and oil results are detailed in Appendix 1 at the end of this report, with the key outcomes presented below

**Sulfur:** There was no significant yield or oil response to the addition of S at 20 kg/ha S (Figure 1). This was regardless of the two2 rates tested (0 and 100 kg/ha) or the N application timings (sowing and budding).

[1] Analyses conducted by Nutrient Advantage Laboratory Services
[2] BOM SILO station number = 055017, station name = PREMER (EDEN MOOR)

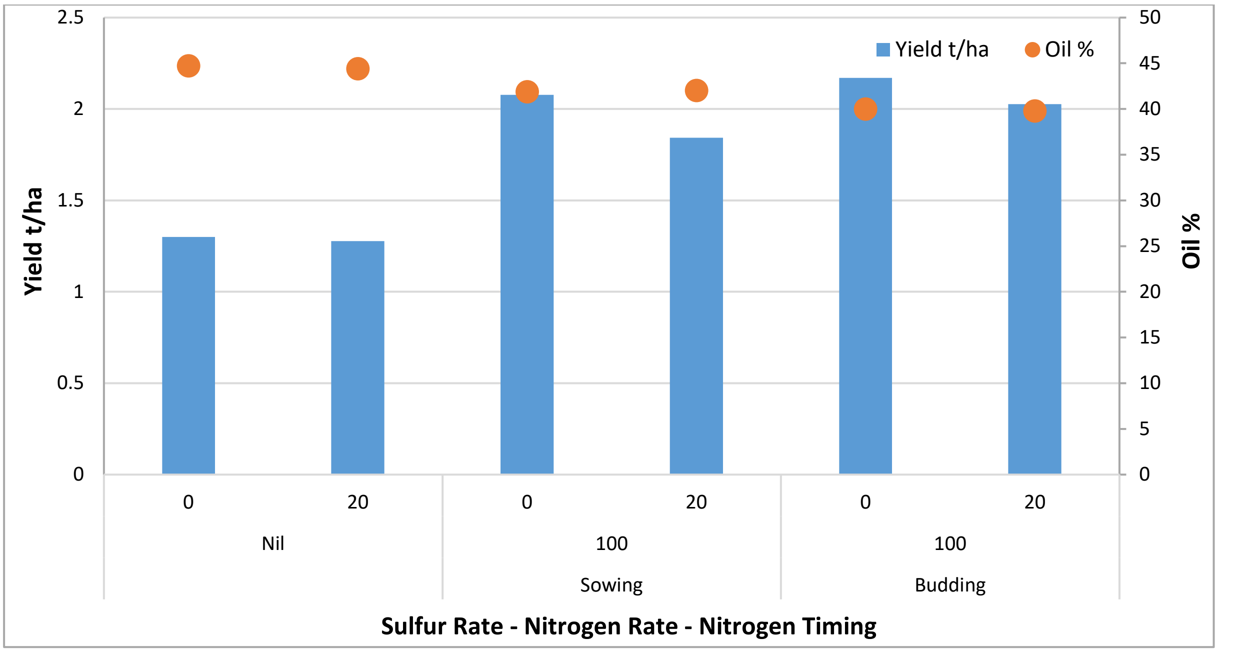


**Figure 1.** Yield and oil % response to applied S at 2 rates and 2 application timings in the high biomass variety 44Y84

**Nitrogen:** There was a clear trend of increasing yields as the N rate increased however tended to plateau out at the higher rates. This response is typical of nutrition response curves, where oil and yield have an inverse relationship, as shown in in **Figure 2** below. However, the crop responsiveness to high rates of N is much higher than expected. It is worth noting is that there are no signs of any yield decline or 'haying off' at the high N rates. All treatments discussed in this section received 20 kg/ha of S.

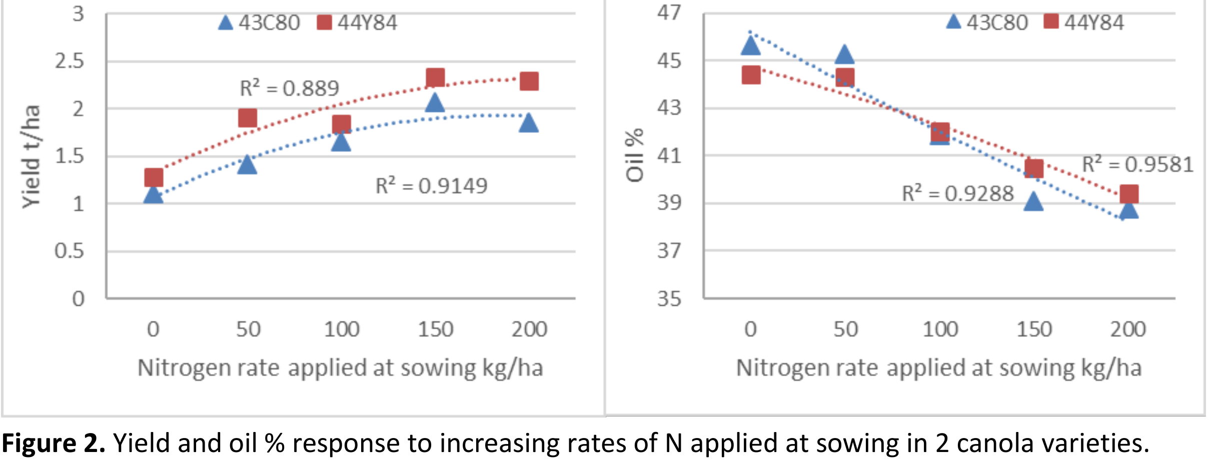


**Figure 2.** Yield and oil % response to increasing rates of N applied at sowing in 2 canola varieties.

Oil % decreased as N rates increased (Figure 2). However total oil yield (yield multiplied by grain oil %), increased. For example, the variety 44Y84 that received 50 kg N at budding had an oil % and oil yield of 42.2% and 0.84 t/ha respectively, while the same variety with 0 N had 44.4% and 0.57 t/ha oil % and yield, a difference of 0.27 t/ha.

**Timing:** The N application timing did not statistically significant effect yields however, oil % was often lower with later application timings. The amount the oil % decreased as N rate increased is illustrated in the variety 44Y84 in Figure 3 below. Where 50 kg N/ha was applied, delaying application until budding resulted in a 1.1% decrease in oil %. Delaying application at the highest N rate had no statistically significant impact on oil %.

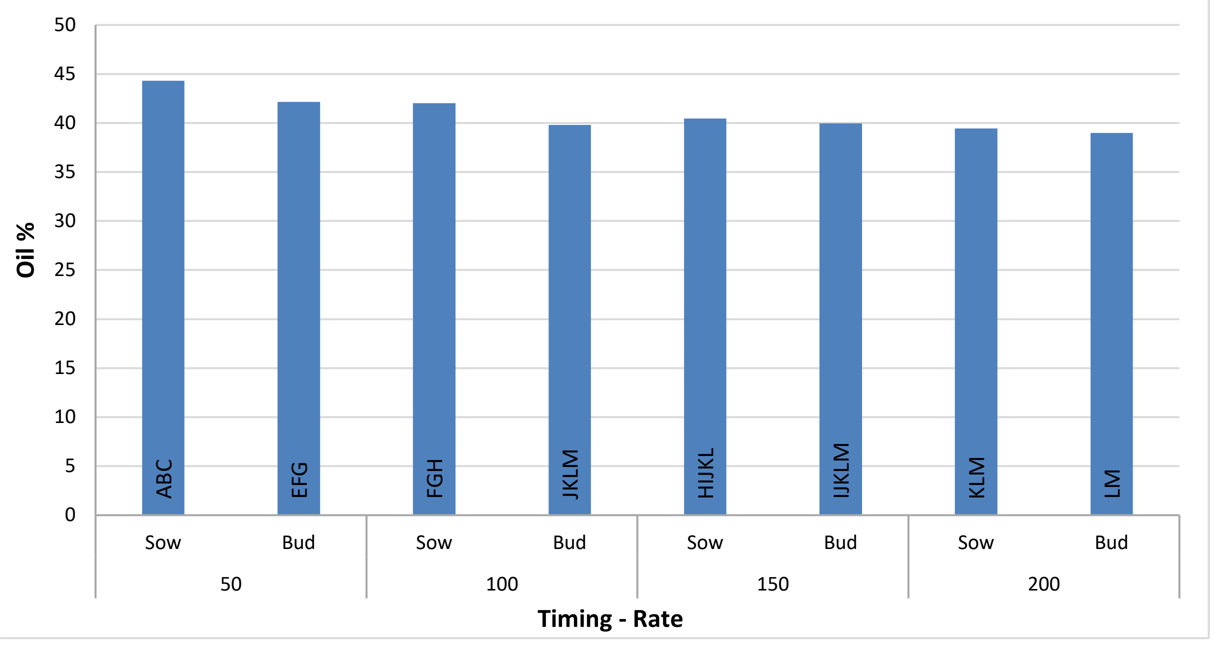


**Figure 3.** Impact on oil % in 44Y84 in response to N application timing and rate

**Plant type:** Both plant types tested in this trial demonstrated similar magnitudes of response to N rate and timing in terms of yield and oil percentage. However, as shown in Figure 2 the lower biomass variety, 43C80, tended to have lower yields (significant at the 50 and 200 N rates for N applied at sowing).

## Economics

As there was no effect from addition of S in this trial and using it would have resulted in lower crop profit (not taking in the benefit to future crops and pastures). In contrast, yields increased with increasing rates of N applied.

Figure 4 below details the net increase to profit in response to increasing N rates applied to 43C80. That is, the value of the yield increase, including any effects by changes in oil %, less the cost of additional fertiliser. The net profit is maximised at 150 kg/ha of N, with ~$300/ha increase in net profit. Above this N level, net profit declines slightly as the yield increase was insufficient to cover the increase in fertiliser costs. In this example oil content declined from 45.6% for the 0 N treatment, down to 41.9% in 150 kg/ha N treatment. This is a decline of 3.7% however, the yield increased has more than compensated for price reductions for grain with lower oil content.

In this trail, the maximum profit varied between different combinations of variety and N timings, but higher N rates were mostly more profitable.

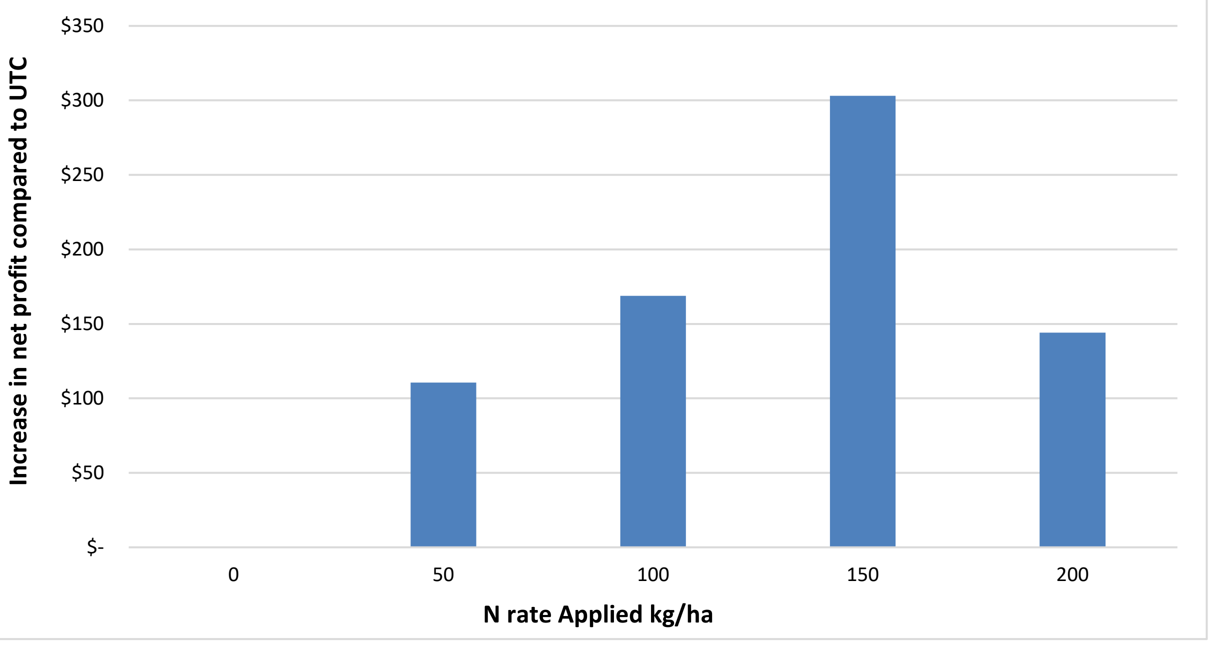


**Figure 4.** Increase in net profit in response to increasing N rates applied to 43C80 at sowing

## Conclusions

For this trial, canola was not responsive to S application. It is, however, good practice to apply a maintenance level of S to replace crop removal. Use of S over and above this is likely to result in additional expense and a lower profit.

In contrast increasing N rates resulted in solid increases in yield and profit. This was despite reductions on oil %, as yield increases more than compensated for lower oil penalties.

The timing of the N applications had little impact on yields. However, there was evidence to suggest that N applications at lower rates closer to sowing, could reduce the negative impact on oil %. Growers should exercise caution when applying N during the sowing as canola is very sensitive to fertiliser burn during establishment.

There was no evidence that high and low biomass genotypes behave differently under higher N strategies. Plant types with a large potential for biomass production under high N situations, did not hay off reducing yields and profitability.

This trial highlights the potential to increase canola profitability through increasing N rates. This information provides the confidence to apply higher rates of N to canola, as risk of depressing yields or the crop ‘haying off’ through excessive fertilizer use is unlikely.

## Acknowledgements

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## Appendix 1

Canola yield and oil responses to various treatments testing biomass potential, S rate, N timing and N rate.

| Biomass potential | S rate (kg/ha) | N timing | N rate (kg/ha) | Yield (t/ha) | | Oil content (%) | |
|---|---|---|---|---|---|---|---|
| High biomass (44Y84) | 0 | N/A | 0 | 1.30 | JK | 44.7 | ABC |
| | 20 | N/A | | 1.28 | JK | 44.4 | ABC |
| | 0 | Sow | 100 | 2.08 | ABCDEF | 41.9 | FGH |
| | 20 | Sow | | 1.84 | DEFGH | 42.0 | FGH |
| | 0 | Bud | | 2.17 | ABCDEF | 40.0 | IJKLM |
| | 20 | Bud | | 2.03 | ABCDEFG | 39.8 | JKLM |
| Low biomass (43C80) | 0 | N/A | 0 | 1.45 | HIJK | 46.1 | A |
| | 20 | N/A | | 1.11 | K | 45.6 | A |
| | 0 | Sow | 100 | 1.96 | ABCDEFG | 42.7 | DEF |
| | 20 | Sow | | 1.66 | GHIJ | 41.9 | FGH |
| | 0 | Bud | | 2.14 | ABCDEF | 39.6 | JKLM |
| | 20 | Bud | | 2.04 | ABCDEFG | 40.8 | GHIJK |
| | | | LSD | 0.40 to 0.45 | | 1.5 to 1.76 | |

Canola yield and oil responses to various treatments testing biomass potential, N timing and N rate.

| Biomass potential | S rate (kg/ha) | N timing | N rate (kg/ha) | Yield (t/ha) | | Oil content (%) | |
|---|---|---|---|---|---|---|---|
| High biomass (44Y84) | 20 | N/A | 0 | 1.28 | JK | 44.4 | ABC |
| | 20 | Sow | 50 | 1.91 | CDEFG | 44.3 | ABC |
| | 20 | | 100 | 1.84 | DEFGH | 42.0 | FGH |
| | 20 | | 150 | 2.34 | AB | 40.5 | HIJKL |
| | 20 | | 200 | 2.29 | ABC | 39.4 | KLM |
| | 20 | Split | 50 | 1.82 | EFGH | 43.7 | CDE |
| | 20 | | 100 | 2.01 | ABCDEFG | 41.0 | GHIJ |
| | 20 | | 150 | 2.10 | ABCDEF | 39.8 | JKLM |
| | 20 | | 200 | 2.24 | ABCD | 39.3 | KLM |
| | 20 | Bud | 50 | 1.99 | ABCDEFG | 42.2 | EFG |
| | 20 | | 100 | 2.03 | ABCDEFG | 39.8 | JKLM |
| | 20 | | 150 | 2.21 | ABCDE | 40.0 | IJKLM |
| | 20 | | 200 | 1.94 | BCDEFG | 39.0 | LM |
| Low biomass (43C80) | 20 | N/A | 0 | 1.11 | K | 45.6 | A |
| | 20 | Sow | 50 | 1.42 | IJK | 45.3 | AB |
| | 20 | | 100 | 1.66 | GHIJ | 41.9 | FGH |
| | 20 | | 150 | 2.07 | ABCDEF | 39.1 | LM |
| | 20 | | 200 | 1.85 | DEFGH | 38.8 | M |
| | 20 | Split | 50 | 1.77 | FGHI | 43.9 | BCD |
| | 20 | | 100 | 2.33 | AB | 41.5 | FGHI |
| | 20 | | 150 | 2.32 | AB | 39.4 | KLM |
| | 20 | | 200 | 2.11 | ABCDEF | 38.7 | M |
| | 20 | Bud | 50 | 1.82 | EFGHI | 42.1 | EFG |
| | 20 | | 100 | 2.04 | ABCDEFG | 40.8 | GHIJK |
| | 20 | | 150 | 1.92 | CDEFG | 39.2 | KLM |
| | 20 | | 200 | 2.36 | A | 38.8 | M |
| | | | LSD | 0.40 to 0.45 | | 1.5 to 1.76 | |