Key messages – response to nitrogen

- Canola growth (dry matter) and seed yield responded positively to N fertiliser in most experiments, with 90% of maximum seed yield achieved at an average of 46kg N/ha. However 90% of maximum gross margin was achieved at a lower average nitrogen rate of 17kg N/ha, due primarily to the relatively small yield increase compared to the reduction in the concentration of oil in the seed with applied N and the cost of N and its application.

- N fertiliser decreased the concentration of oil in the seed of canola at a rate of 0.01-0.04% oil per kg N/ha.
  - We found the rate of decrease in oil concentration was greater in low rainfall regions and in experiments where the seed yield response to N was small (<200 kg/ha)

- In 80% of cases the first 10kg N/ha applied provided a return on investment in N greater than $1.50 for every $1 invested. The next 20kg N/ha applied provided a return on investment of $1.25 for every $1 invested in N 80% of the time and further increases would most likely breakeven.

Figure 3 Relationship between total available nitrogen from soil, plant residue and fertilisers and the seed yield of canola (% of maximum of individual variety at each site) in lower rainfall sites in WA 2012-2014
Nitrogen rates are more important than timings in high rainfall canola in Western Australia

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Key messages

• Canola yields, oil percentages and gross margins respond more to rates of applied nitrogen than timing.
  - Increasing nitrogen rates generally increased canola grain yield and reduced oil.
• In high rainfall areas we suggest growers continue to apply most of the nitrogen in the first eight weeks (that is, before the green bud is visible/stem elongation begins) to set up high biomass and yield potential.
  - Further top-up nitrogen decisions can be delayed until flowering (12 weeks after sowing) or even as late as 14 weeks in coastal areas (for example, Gibson) or 16 WAS in cooler inland areas (Kojonup) as the seasonal outlook unfolds.
  - We found Triazine tolerant (TT), hybrid Roundup Ready® (RR) and hybrid Clearfield (CL) responded similarly to the rate and timing of applied nitrogen.

Background

The majority of canola growers apply top-up nitrogen within eight weeks of sowing – prior to the start of stem elongation. We wanted to see if nitrogen applied later in the year at the start of flowering (or later) provided a similar response to nitrogen applied earlier. We conducted six trials from 2013-2016 in high rainfall zones (Kojonup and Gibson) using a range of nitrogen rates and timing strategies to investigate if elite open pollinated (OP) cultivars of Triazine tolerant (TT), hybrid Roundup Ready® (RR) and hybrid Clearfield (CL) canola continue to respond to nitrogen past 12 weeks (start of flowering) or even 14-16 weeks (mid flowering and early pod set).

Results and Discussion

Canola yield and oil percentage responded to applied nitrogen at all six sites (Figure 2). Yield was optimised at rates of applied nitrogen ranging from 100kg N/ha at Kojonup in 2014 and 2016 to 150kg N/ha at Kojonup in 2013.

On average canola yielded 7kg/ha per unit of nitrogen applied for the first 25kg of nitrogen applied (0-25kg N/ha), 6kg/ha for the next 25kg of N applied (25-50kg N/ha), 4kg/ha for the next 25kg N/ha (50-75kg N/ha) and 3kg/ha for every unit of N above 75kg N/ha.
Oil percentage decreased as the rate of applied nitrogen increased at an average rate of -0.004% for every unit of nitrogen applied.

The diminishing gain in yield with increased applied nitrogen relative to the cost of increasing nitrogen, combined with the negative effect of applied nitrogen on the concentration of oil in the seed resulted in optimum gross margins being achieved at markedly lower rates of applied nitrogen than seed yields. On average optimum gross margins were achieved at 50% of the rate of nitrogen which produced optimum seed yield – ranging from 25kg N/ha at Gibson in 2014 (compared to 150kg N/ha for maximum yield) to 100kg N/ha at Kojonup in 2014 which maximised both yield and gross margins.

It should be noted that maximum gross margins were achieved over a wide range of applied nitrogen – including the highest rates tested (with the exception of the 250kg N/ha treatment at Gibson in 2013) – such that on most occasions it is the opportunity cost of the dollars spent on nitrogen rather than another input around the farm that needs to be considered. That is, high rainfall growers are unlikely to lose money by applying too much nitrogen on their canola - they just might make more money by spending that dollar somewhere else.

Generally time of nitrogen application had no significant effect on grain yield, gross margins and oil concentration. See Figure 3 for an example of the effect of split/late timing of application of the same total rate of nitrogen (100kg N/ha) at Kojonup in 2016. In the two trials conducted in 2013 at Gibson and Kojonup when the same total amount of nitrogen applied at seeding is compared to other timings in 96% of cases, timing of nitrogen had no effect on grain yield; in 92% of cases timing of nitrogen had no effect on gross margins and in 100% of cases timing of nitrogen had no effect on oil percentage. In the trials conducted in 2014, 2015 and 2016 which included later timing of applications, out of 36 split nitrogen treatments timing of nitrogen application had no effect on any of the comparisons for grain yield and gross margins. Oil was not affected by time of application for lower rates of applied nitrogen (up to 80kg N/ha) at any of the sites. However, split application of 240kg N/ha in 2013 at Gibson and 100kg and 125kg N/ha in 2014 at Kojonup significantly reduced oil percentage.

In the majority of instances varieties or herbicide tolerance system had no effect on the response to nitrogen or nitrogen timing. In four out of the six experiments, varieties produced similar yields, whilst at Gibson in 2014 RR hybrid variety Hyola® 404RR produced higher yields of 2.3t/ha than the OP TT variety ATR Wahoo at 2.0t/ha and at Kojonup 2016 both the OP TT and RR hybrid varieties produced higher yields (2.3t/ha) than the Clearfield hybrid variety (2.0t/ha). Kojonup 2016 was also the only experiment where we measured a difference in the gross margin of varieties - with the CL hybrid variety having lower gross margins than the OP TT and RR hybrid varieties.

The seed yield, oil percentage and gross margins of all types of canola reacted in