Department of **Agriculture** and **Food**

GOVERNMENT OF WESTERN AUSTRALIA

GRDC Grains Research & Development Corporation

DAW00227
Tactical Break Crop Agronomy in Western Australia

Summary of timing and rate of N for lower rainfall canola series

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Location of trials	2012 – Grass Patch 2013 – Cunderdin, Eradu, Holt Rock, Katanning, Merredin, Salmon Gums, West Dalwallinu, Wittenoom Hills and Wongan Hills 2014 - Chapman, Cunderdin, Ogilvie, Salmon Gums and Wongan Hills

Summary (Key messages)

Canola yields in low and medium rainfall regions of south-western Australia are inherently low and variable. We have shown that although N fertilisation increases the yield of canola, the yield increases are often relatively low. Nitrogen also reduces the concentration of oil in the seed of canola and the rate of decrease can be rapid in low rainfall areas.

The combined effect of N on yield and oil, along with the current payment structure for high oil canola, results in uncertain economic returns from N fertilisation in low to medium rainfall areas.

We found that 90% of maximum gross margin was achieved at an average nitrogen rate of 17 kg N/ha, and the first 10 kg N/ha gave a return on investment in N greater than $1.50 per $1 in 80% of occurrences (experiments x variety combinations). The next 20 kg N/ha applied gave a return on investment in N of $1.25 for every $1 spent on N in 80% of occurrences, and further increases were most likely to breakeven.

We have shown that while farmers should continue to plan to apply N onto canola within the first eight weeks, delaying top-up N until 12 weeks after sowing – when the canola crop is near flowering, is a viable second option which provides some level of risk management for canola growers in low and medium rainfall areas in south-western Australia.

Background

The area of canola (*Brassica napus* L.) sown in the grain growing regions of Western Australia (WA) has expanded from 106,000 ha in 1997 to 1.16 million ha in 2013. During this time period the area sown has expanded by six fold in high rainfall (>450 mm annual rainfall) regions, 13-fold in medium rainfall (350 – 450 mm) regions, and 19-fold in low rainfall (< 350 mm) regions. In 2013, 81% of the canola area in WA was in low (19%, 226,000 ha) and medium (62%, 717,000 ha) rainfall regions.

While the area of canola sown in WA is extensive, seed yields are inherently low. During the period 1997 to 2013 the average canola yield in WA was 1.1 t/ha with yields in the low rainfall area averaging approximately 70% of the state's average. Despite these low yields farmers persist with canola due to both the high relative grain price and the break crop value it provides for their cropping systems.

While persisting with canola at these low yield levels, farmers seek to reduce their financial risk. One way to reduce risk is to reduce inputs. Some inputs such as weed and insect control are often mandatory, while fertiliser inputs, particularly nitrogen (N) are often considered optional, and at a cost of $1 to $1.50/kg, N is a major input cost. Throughout the world canola is reputed to have a high requirement for N, while in south-western WA the amount of N required for maximum seed yield production is usually more N than that supplied by soil. Therefore fertiliser N is often used to optimise the growth of canola and maximise seed yield. However adequate to high levels of fertiliser N have been shown to decrease oil concentration in the seed of canola. Therefore it is important to match N inputs to anticipated yield levels and avoid reducing the concentration of oil in the seed.

Canola responds to fertiliser N at a wide range of growth stages For example, previous work in Victoria showed that canola produced similar results when N was applied either at sowing or at early flowering bud stage. The capacity of canola to respond to late-applied N may allow growers to reduce their financial risk by delaying decisions on inputs until they have a good assessment of the yield potential of their crop, and if the seasonal outlook is poor, perhaps reduce inputs. To assist WA farmers in low and medium rainfall areas making decisions on N inputs we conducted a number of experiments to assess the response of canola to N and to determine if the timing of N could be delayed in WA until later in the growing season.

Aim

Assess the response of canola to N and to determine if the timing of N could be delayed in WA until later in the growing season.

Trial Details

Fifteen N experiments were conducted over three years from 2012 to 2014 in the low to medium rainfall zones in south-west Western Australia.

Table 1 –The soil classification, some chemical properties of the < 2mm fraction of the soil surface (0-10 cm) measured on samples collected before seeding and estimated mineral N supply at 15 nitrogen experimental sites in 2012-2014.

Location	WA Soil Group	pH ($CaCl_2$)	P (mg/kg)	K (mg/kg)	Organic carbon (%)	Estimate of Total N from soil and plant residues (kg N/ha)
Grass Patch 2012	Alkaline grey shallow sandy duplex	6.9	35	350	1.0	83
Cunderdin 2013	Yellow sandy earth	5.9	34	109	0.86	61
Eradu 2013	Yellow deep sand	6.0	23	69	0.86	76
Holt Rock 2013	Deep sandy Gravel	5.2	55	122	1.42	71
Katanning 2013	Duplex sandy Gravel	4.7	54	112	2.9	48
Merredin 2013	Duplex sandy Gravel	5	32	166	0.55	73
Salmon Gums 2013	Alkaline grey shallow loamy duplex	5.4	44	313	0.8	58
West Dalwallinu 2013	Yellow Deep Sand	4.7	24	76	0.47	45
Wittenoom Hills 2013	Alkaline grey shallow loamy duplex	7	26	387	1.8	41^

Location	WA Soil Group	pH ($CaCl_2$)	P (mg/kg)	K (mg/kg)	Organic carbon (%)	Estimate of Total N from soil and plant residues (kg N/ha)
Wongan Hills 2013	Yellow Deep Sand	5.8	26	95	1.01	152
Chapman 2014	Brown Deep sand	5.9	36	100	0.72	49
Cunderdin 2014	Yellow-brown deep sandy duplex	5.2	24	76	1.49	46
Ogilvie 2014	Yellow sandy earth	5.4	22	57	0.57	58
Salmon Gums 2014	Alkaline grey shallow loamy duplex	5.1	37	243	0.69	59
Wongan Hills 2014	Yellow deep sand	6.4	31	106	1.2	123

Treatment detail

Split plot design – Main plots – herbicide group, sub plots – varieties x N rates/timings, 3-4 replicates

The rates of applied N in 2012 and 2013 were 0, 25, 50, 75, and 100 kg/ha in five low rainfall experiments; and 0, 25, 50, 75, and 150 kg/ha in five medium rainfall experiments. In 2014 rates of applied N were 0, 10, 30, and 70 kg/ha in two low rainfall and three medium rainfall experiments. Nitrogen was applied as urea (46% N) in either a single dose or applied over two to four doses/times: either directly in front of the seeding equipment at seeding by diverting fertiliser hoses to the front of the seed, and/or 4 weeks after seeding (WAS), 8WAS and/or 12WAS by hand. In 2014 at Salmon Gums the post-seeding treatments used liquid N (urea ammonium nitrate -UAN 42% N) applied with a handheld boom spray. 12 treatments:

In 2012 the cultivars tested were CB Telfer (triazine tolerant (TT) open pollinated (OP), very early maturity), CB Tanami (TT OP, early maturity), CB Junee HT (TT hybrid, early maturity), GT Cobra (Roundup Ready® (RR) OP, early-mid maturity), Hyola 404RR (RR hybrid, early-early mid maturity), and Pioneer 43Y23RR (RR hybrid early maturity). In 2013 Hyola 404RR and ATR Stingray (TT OP, early-mid maturity) were compared at medium rainfall sites, and Hyola 404RR and CB Telfer were compared at low rainfall sites. In 2014 43Y23RR and Sturt TT (TT OP, early – mid maturity) were tested at all sites.

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Results

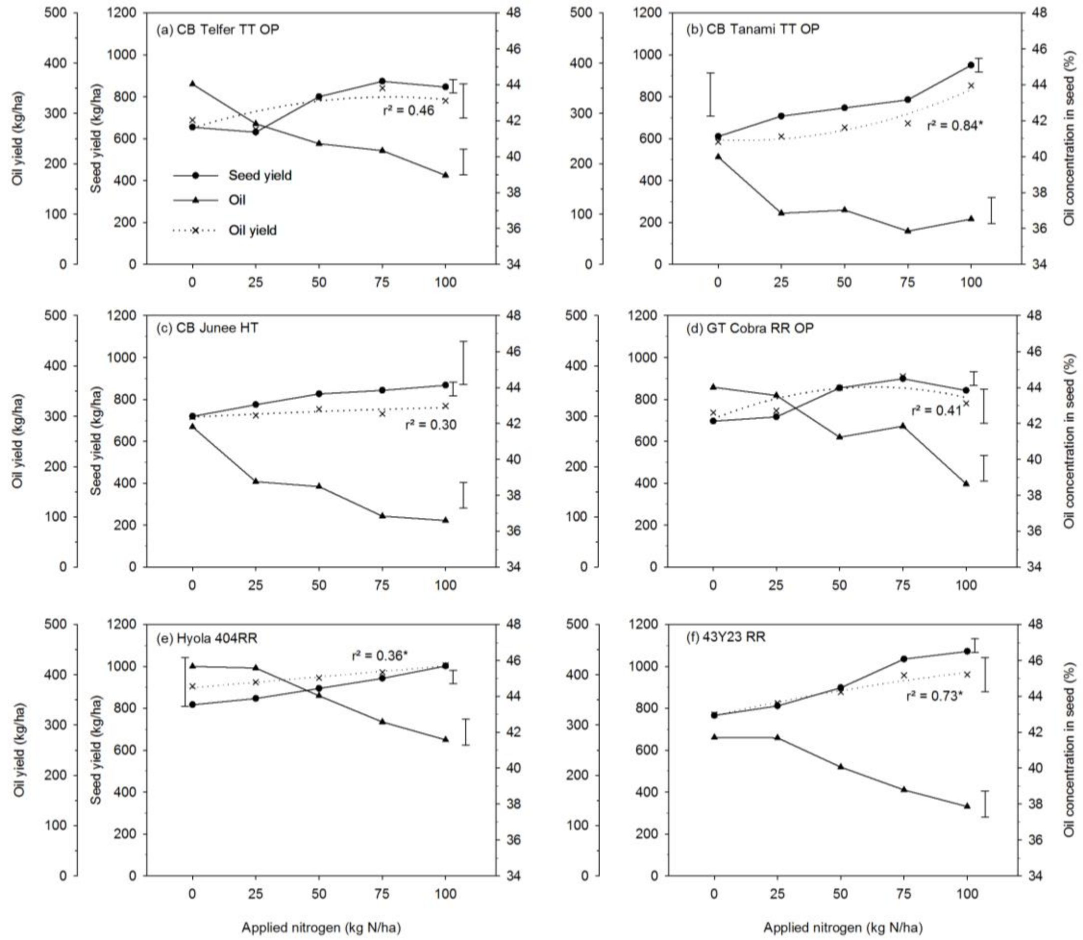

Figure 1 Seed yield, oil concentration in seed and oil yield response of canola varieties to applied nitrogen at Grass Patch in 2012. Vertical bars indicate l.s.d. at $P = 0.05$.

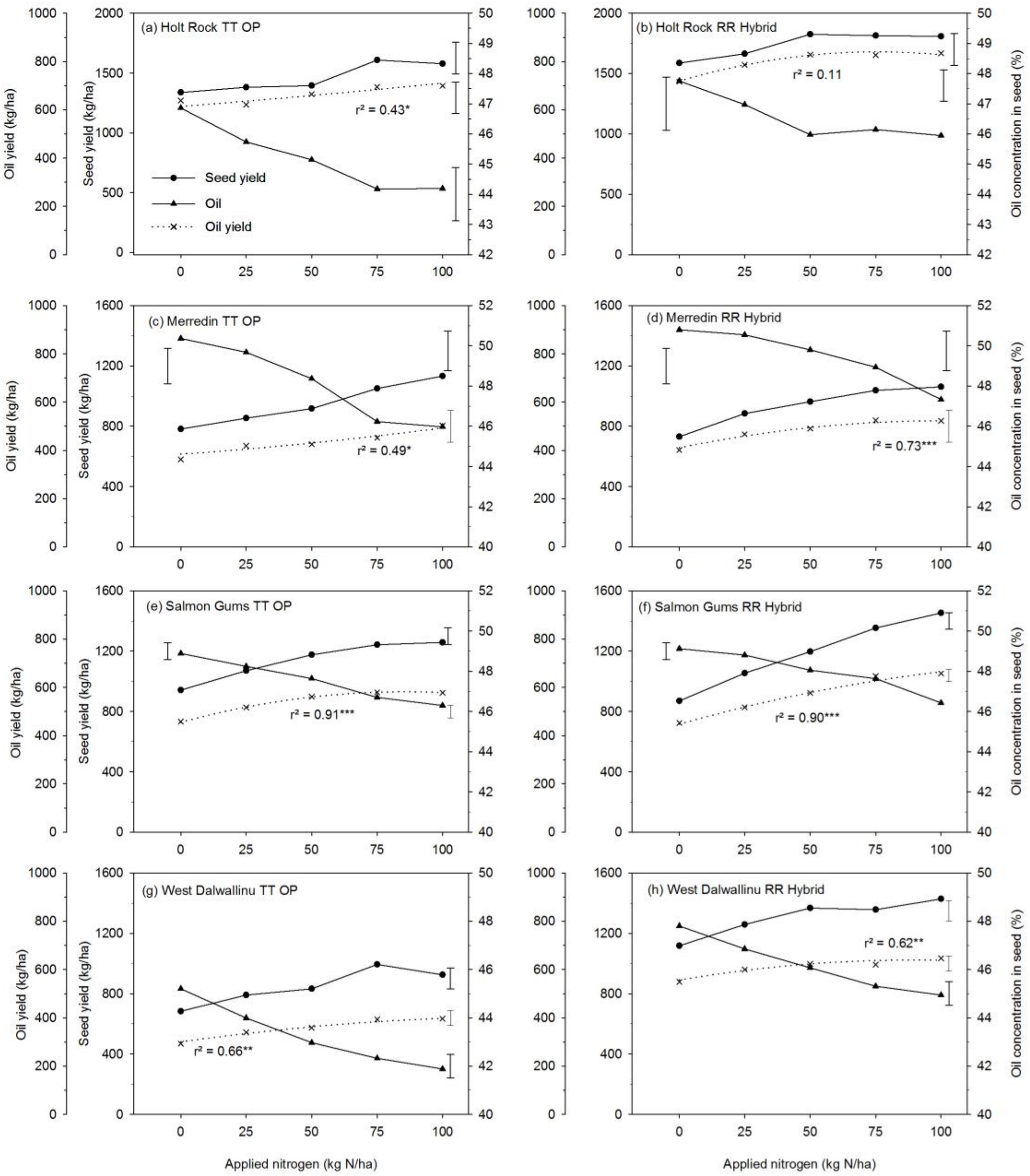

Figure 2 Seed yield, oil concentration in seed and oil yield response of triazine tolerant open pollinated (TT OP) and RoundupReady (RR) hybrid canola to applied nitrogen at four sites in 2013 where maximum applied N was 100 kg/ha. Vertical bars indicate l.s.d. at *P* = 0.05.

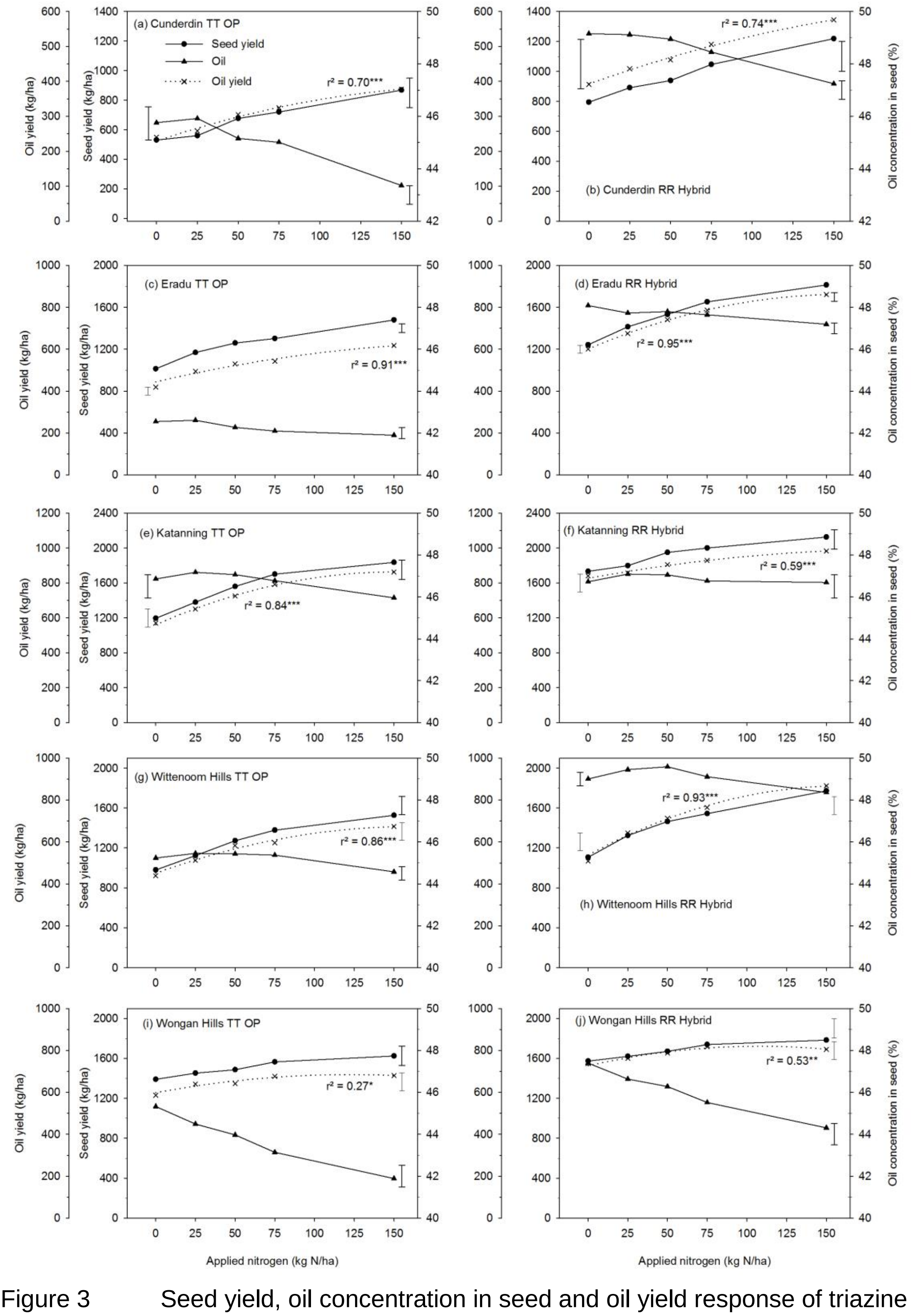

Figure 3 Seed yield, oil concentration in seed and oil yield response of triazine tolerant open pollinated (TT OP) and RoundupReady (RR) hybrid canola to applied nitrogen at five sites in 2013 where maximum applied N was 150 kg/ha. Vertical bars indicate l.s.d. at $P = 0.05$.

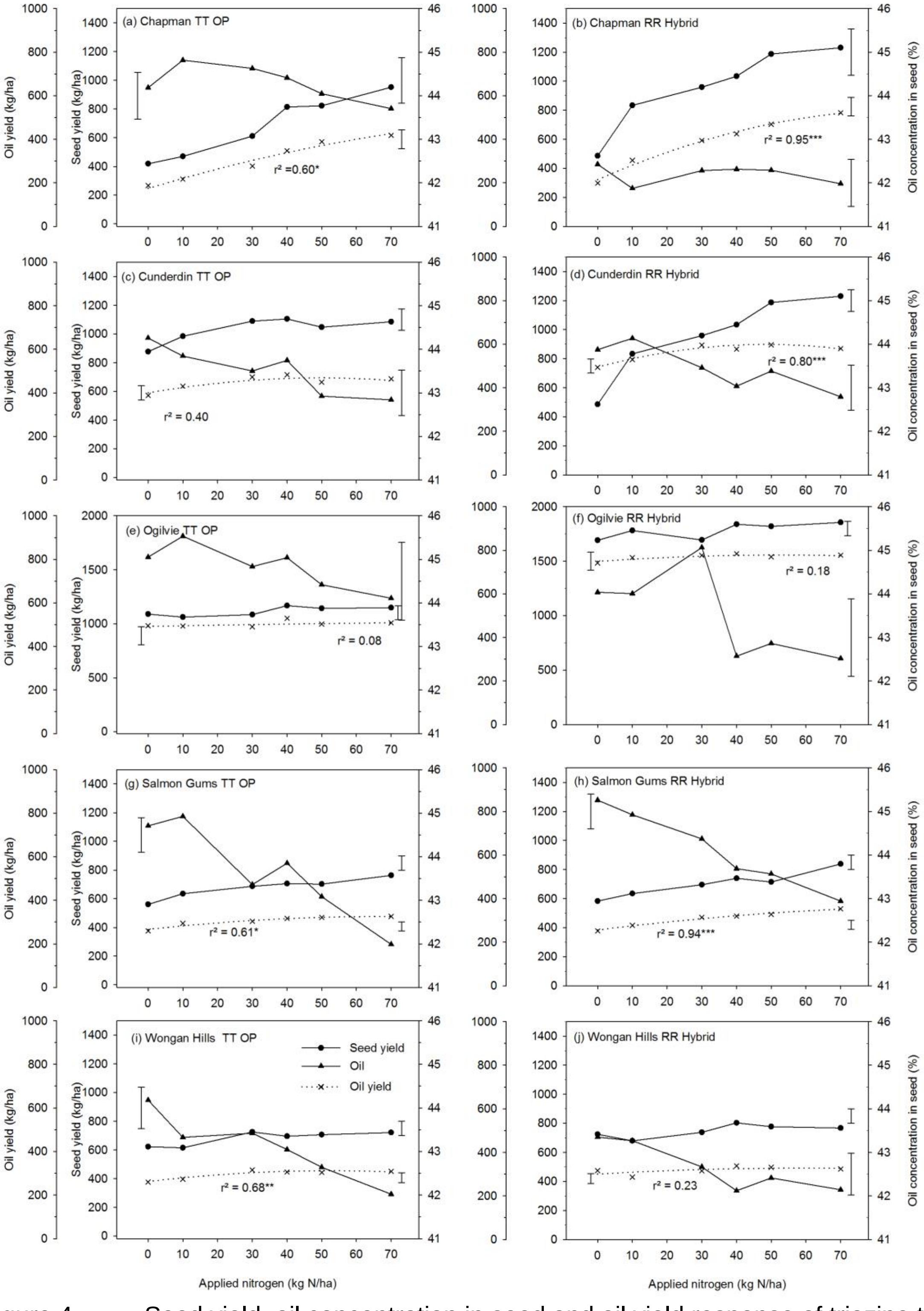

Figure 4 Seed yield, oil concentration in seed and oil yield response of triazine tolerant open pollinated (TT OP) and RoundupReady (RR) hybrid canola to applied nitrogen at five sites in 2014. Vertical bars indicate l.s.d. at $P = 0.05$.

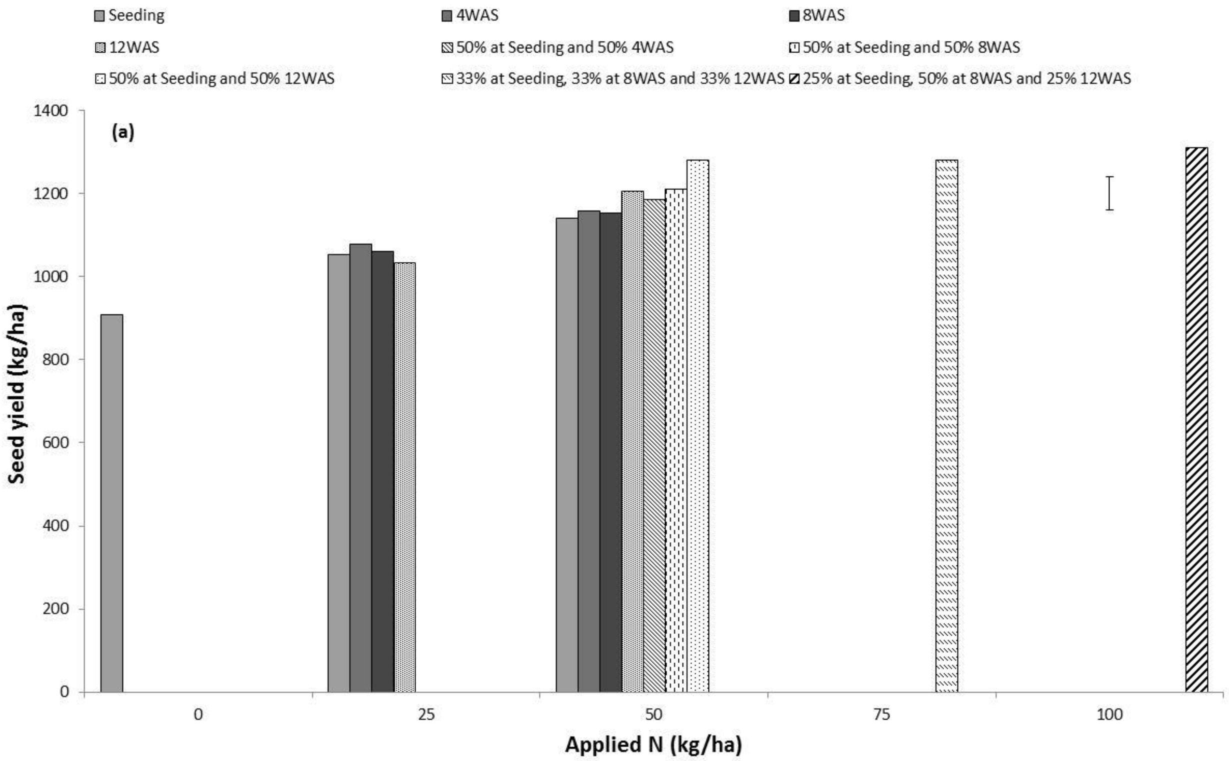
Seeding
4WAS
8WAS
12WAS
50% at Seeding and 50% 4WAS
50% at Seeding and 50% 8WAS
50% at Seeding and 50% 12WAS
33% at Seeding, 33% at 8WAS and 33% 12WAS
25% at Seeding, 50% at 8WAS and 25% 12WAS
(a)
Seed yield (kg/ha)
1400
1200
1000
800
600
400
200
0
0
25
50
75
100
Applied N (kg/ha)

Fig 5a

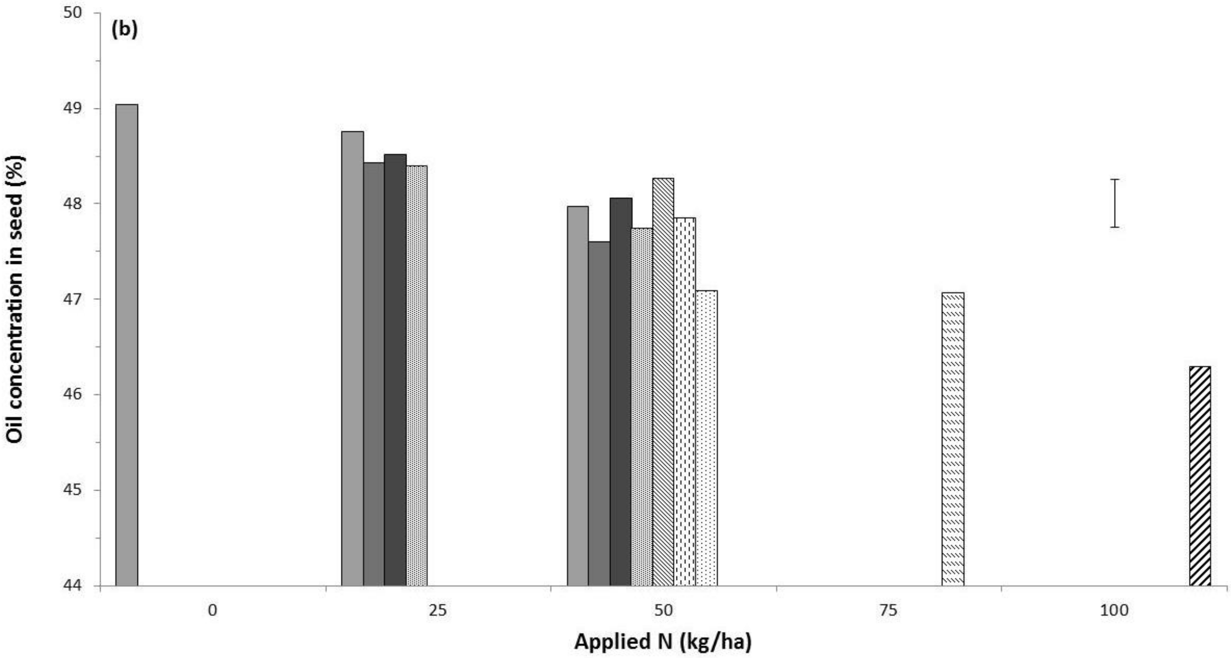
(b)
Oil concentration in seed (%)
50
49
48
47
46
45
44
0
25
50
75
100
Applied N (kg/ha)

Fig 5b

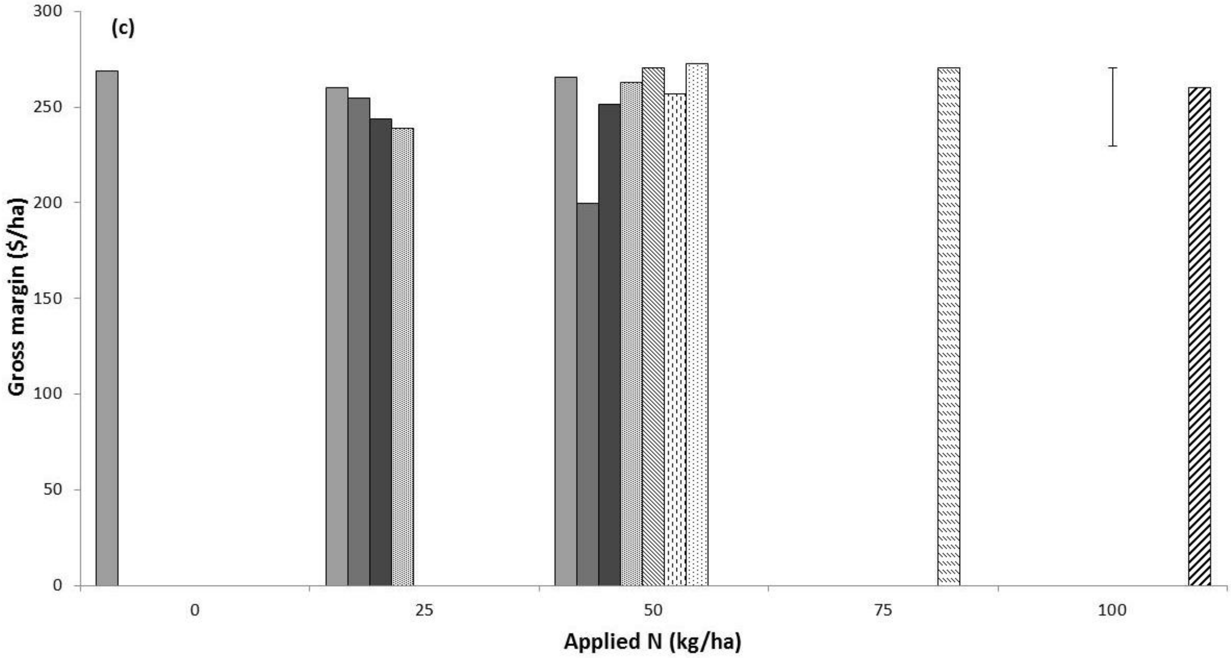

Fig 5c

Figure 5: Responses to single and split applications of nitrogen in 2013 low rainfall experiments where highest rate was 100 kg N/ha (METanalysis of Holt Rock, Merredin, Salmon Gums and West Dalwallinu). (a) Seed yield, (b) oil concentration in seed and (c) gross margin. Legend indicates timing of split applications of N. WAS = weeks after sowing. Vertical bars indicate l.s.d. at P = 0.05.

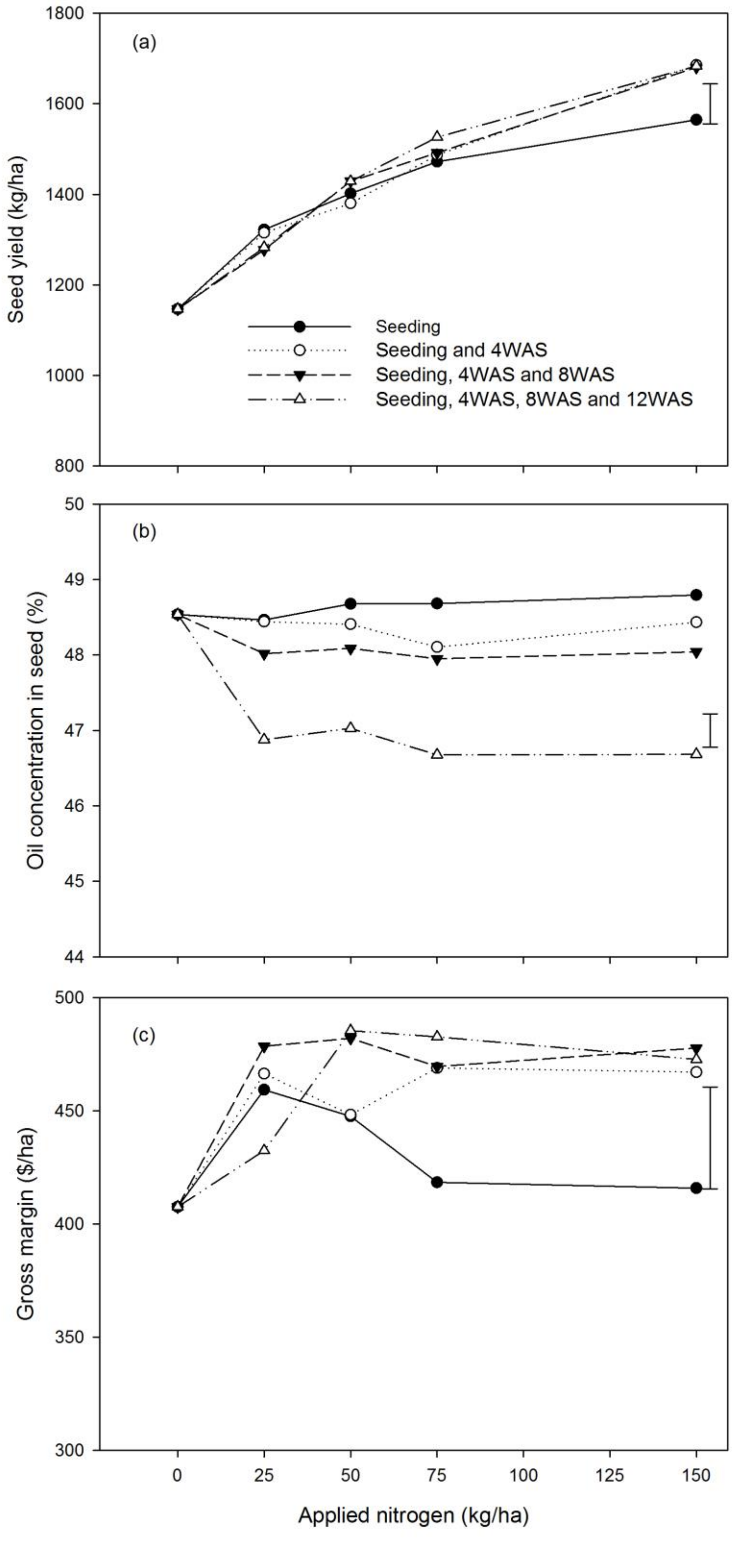

Figure 6: Responses of (a) seed yield, (b) oil concentration in seed and (c) gross margin to split applications of nitrogen in 2013 medium rainfall experiments where highest rate was 150 kg N/ha (METanalysis of Cunderdin, Eradu, Katanning, Wittenoom Hills and Wongan Hills)). Legend indicates timing of split applications of N. WAS = weeks after sowing. Vertical bars indicate l.s.d. at P =0.05.

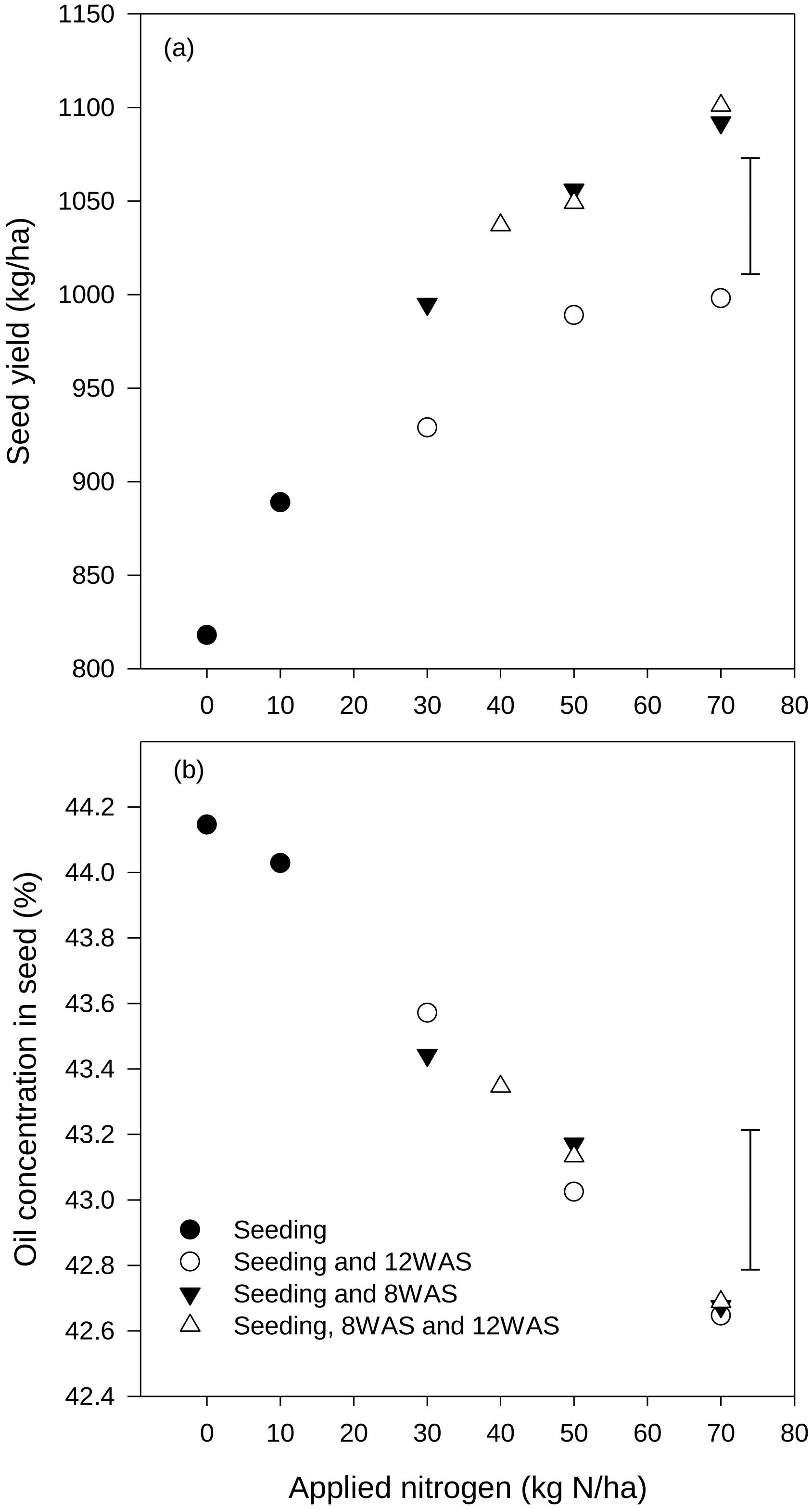

Figure 7: Seed yield and concentration of oil in seed in relation to rate and time of nitrogen application in 2014 (METanalysis of Chapman, Cunderdin, Ogilvie, Salmon Gums and Wongan Hills). Vertical bars indicate l.s.d. at P = 0.05.

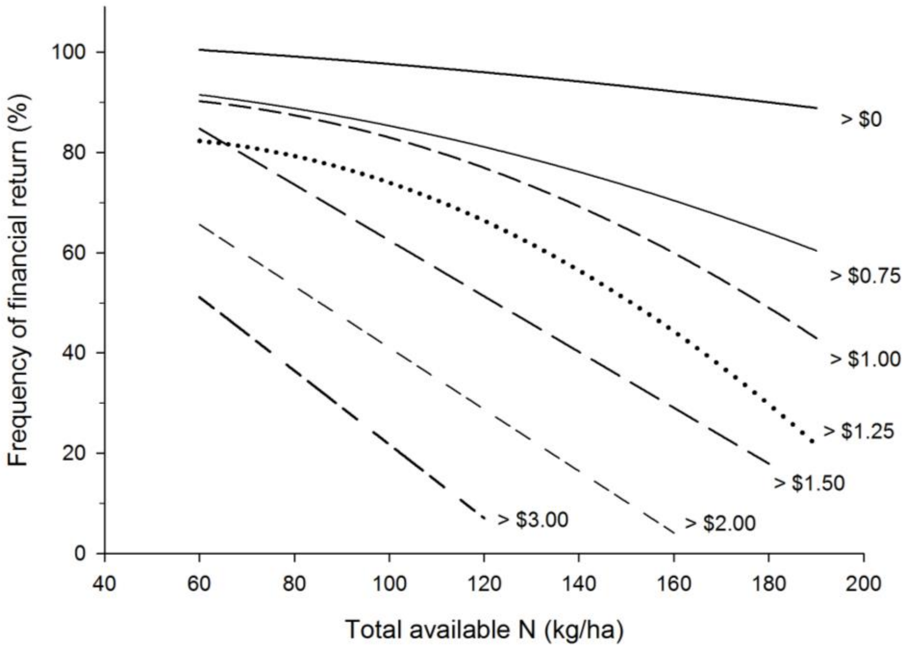

Figure 8 Frequency of obtaining a range of financial returns by supplying nitrogen from soil, plant residue and fertiliser sources to canola. Lines represent the frequency of returning at least $0 for $1 invested, $0.75 for $1 invested, $1 for $1 invested, $1.25 for $1 invested, $1.50 for $1 invested, $2 for $1 invested or $3 for $1 invested.

Conclusion

On average, RR hybrid produced 250 kg/ha or 23% more seed and 2.2% more oil than TT OP canola, and the average gross margin of RR hybrid was $65/ha more than TT OP. However, seed yield and gross margin differences between RR hybrid and TT OP canola were reduced when seed yields were below 1400 kg/ha.

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 46 kg N/ha. However 90% of maximum gross margin was achieved at a lower average nitrogen rate of 17 kg 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.

As canola growers of south-western Australia are now paid an uncapped premium for canola grain with oil concentration above 42%, decreases in oil% have a significant financial effect and recommended rates of N should be lower than those calculated to optimise seed yield. In 80% of cases the first 10 kg N/ha applied provided a return on investment in N greater than $1.50 for every $1 invested. The next 20 kg 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.

The timing of nitrogen application had a minor effect on yield, oil and financial returns but delaying N application would allow farmers to reduce risk under poor conditions by reducing or eliminating further inputs.

Overall our work demonstrates that a conservative approach to N supply that is mindful of the combined impacts of N on yield and oil is necessary in south-western Australia and that split and delayed applications are a viable risk-management strategy.

Acknowledgements

This trial is one of a series conducted throughout WA as part of the GRDC/DAFWA co-funded project “Tactical Break Crop Agronomy in Western Australia”.

Links

For other reports related to this trial see DAFWA web site and search ‘Trial reports canola 2013 and 2014”.

A full report is available from the authors or by visiting the Crop and Pasture Science Journal on the web.

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