Nitrogen management of hybrid and open-pollinated canola in the WA low rainfall mallee

Start Date: **May 2012** **Finish Date: Report due by April 2013**

GRDC Theme: Profitable Farming Systems

GRDC Region: Western Region

Regional Zone: Regional Cropping Solutions Esperance Zone – Project 1 of 4 Hybrid Canola Nitrogen Management in low rainfall mallee areas

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Project Supervisor

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Introduction

Initial small scale trial work in 2011 found that there was some benefit in nitrogen application to hybrid canola varieties above the benefits seen by application of nitrogen to other canola types. In 2012 we repeated this work with more cultivars and also investigated the timing of nitrogen, which is ill-defined for low rainfall areas in the mallee region.

Background to the project.

In 2011 DAFWA conducted nitrogen management of hybrid and open-pollinated canola in the low rainfall WA mallee. In that trial it appeared hybrids continued to respond to nitrogen in terms of GY and $/ha compared to Open Pollinated varieties in both TT and RR technologies. Also hybrids at rates of N below 25 kg N/ha produced equal or better yields than OP varieties at higher rates. This opened up the idea of using the improved genetics of hybrids with low rates of N near seeding, watching the season and applying more N as the season allows.

There are gaps currently in this area which can be addressed with this trial. The research and extension gaps include:

- Lack of suitable break crops – better agronomy packages for hybrid canola will enable this crop to be established as a profitable break crop for the low rainfall mallee areas. Hybrids have good seedling vigour and generally better yield potential than OP or other canola types.

- Nitrogen use efficiency – there are numerous trials/studies that have been undertaken that show that compared to OP varieties, Hybrid canola varieties appear to be more efficient users of N (Brandt, Ulrich et al). However these studies were done quite some time ago and very few have been conducted to WA conditions. New cultivars could change how nutrition in hybrids is managed in low rainfall areas.

- Hybrid canola cultivars have been introduced in medium to high rainfall environments in WA, but less is known about their performance and response to nitrogen in low rainfall areas.
- A general lack of agronomy knowledge surrounding hybrid canola management

Objectives

To investigate the nitrogen rate and time of application response of canola varieties to yield and oil content of TT and RR hybrids in comparison with open-pollinated types to:

1. Provide growers in lower rainfall environments with guidelines on optimal nitrogen rates and times of application to maximise grain and oil yields.
2. Determine if the management of hybrid canola nutrition is different to that of open pollinated varieties due to different responses to N rates and timing.

Methodology

The experiment consisted of three Roundup Ready cultivars (two hybrid – Hyola 404 RR and Pioneer 43Y23 RR, and one OP – GT Cobra) and three TT cultivars (one hybrid – CB Junee HT, and two OP – CB Telfer and CB Tanami). Nitrogen treatments were 0, 25, 50, 75 and 100 kg N/ha applied in split applications. In addition 100 kg N/ha was applied either at seeding, 4 weeks after sowing (WAS, @ 2-4 leaf)), 8WAS (@ 6 leaf) and 12 WAS (near bud at top of canopy).

Diary

Date	Job	Trt Group	Tank	Rate/Ha	Application rate/ha	Comments
27-Apr	Pre Sowing	Sprayed	Whole Trial	30	mL	Hammer
27-Apr	Pre Sowing	Sprayed	Whole Trial	1.5	L	Roundup powermax
30-Apr	At Sowing	Sown				Canola
30-Apr	Pre Sowing	Sprayed	Whole Trial	2	Lt	Sprayseed
30-Apr	Pre Sowing	Sprayed	Whole Trial	2	Lt	Trifluralin
30-Apr	Pre Emergent	Sprayed	Whole Trial	200	mL	Talstar
30-Apr	At Sowing	Topdressed	Whole Trial	60	kg	Summit Pasture
30-Apr	At Sowing	Topdressed	Treatments		Urea	Treatments
17-Jun	Post Emergent	Sprayed	RR	0.9	kg	Roundup Ready Herb
3-May						Topdressed gypsum and fixed up N treats
28-May						4WAS treats applied, 2-4 leaf stage
18-Jun	Post Emergent	Sprayed	TT	1.1	kg	Atragranz
18-Jun	Post Emergent	Sprayed	TT	1	%	Hasten
25-Jun						Tissue samples taken
26-Jun						8WAS treats applied, 4-6 leaf stage
4-Jul	Post Emergent	Sprayed	Whole Trial	120	g	Lontrel Granule
4-Jul	Post Emergent	Sprayed	Whole Trial	0.5	%	Uptake
4-Jul	Post Emergent	Sprayed	Whole Trial	0.1	L	Verdict 520
23-Jul						12WAS treats applied, early flowering
3-Sep	Post Emergent	Sprayed	Whole Trial	400	mL	Alpha-Cypermethrin
4-Oct						N samples taken
16-Oct						TDM/YC samples taken
22-Oct	Post Emergent	Sprayed	Whole Trial	3	L	Reglone
22-Oct	Post Emergent	Sprayed	Whole Trial	0.16	%	Wetter
29-Oct	Harvest	Whole Trial		---		

Site and Season Characterisation

Rainfall Data (mm)

Year: 2012

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
49	12	58	3	15	40	34	22	25	8	64	12

Annual	Pre-sowing	Stored pre sowing	GSR (May to Oct.)	GSR+store
342	181	49	144	193

Average since 1974

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
30	21	26	29	41	35	40	38	33	30	30	19

Annual	Pre-sowing	Stored pre sowing	GSR	GSR+store
347	153	49	217	266

Potential yield in 2012 assuming 10 kg/ha/mm was:

Potential yield = (GSR + stored water – (GSR + stored water * 1/3)*10 = (193-64)*10 = 1.29 t/ha

Potential yield = (GSR + stored water – (110)*10 = (193-110)*10 = 0.83 t/ha

Site Soil Group and Profile Description

Position in landscape	Mid slope
Soil Group	Sandy loam

Table 1 CSBP test

Lab Number		XXS12051	XXS12052	XXS12053	XXS12054	XXS12055
Code		ES5088	ES5089	ES5090	ES5091	ES5092
Depth		0-10	10 to 20	20 to 30	30 to 40	>40
Colour		GRBR	LTBR	LTBR	LTBR	LTBR
Gravel	%	5	0	0	0	0
Texture		1.5	2.5	3	3	3
		Loamy sand	Clay loam	Clay	Clay	Clay
Ammonium Nitrogen	mg/Kg	3	2	2	2	2
Nitrate Nitrogen	mg/Kg	17	9	11	9	8
Phosphorus Colwell	mg/Kg	35	18	10	8	6
Potassium Colwell	mg/Kg	350	431	570	760	769
Sulphur	mg/Kg	11.1	9.5	7	8.6	12.5
Organic Carbon	%	1.0	0.37	0.43	0.2	0.21
Conductivity	dS/m	0.142	0.241	0.209	0.501	0.567
pH Level (CaCl2)	pH	6.9	8.1	8.3	8.7	8.6
pH Level (H2O)	pH	7.4	9	9.1	9.6	9.5
DTPA Copper	mg/Kg	0.59	0.75	1.05	1.51	1.68
DTPA Iron	mg/Kg	14.02	13.6	18.88	16.5	16.38
DTPA Manganese	mg/Kg	10.72	2.89	3.54	4.57	3.62
DTPA Zinc	mg/Kg	0.63	0.26	0.24	0.19	0.21
Exc. Aluminium	meq/100g	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Exc. Calcium	meq/100g	7	5.43	7.41	6.58	7
Exc. Magnesium	meq/100g	1.9	4.59	7.4	8	7.03
Exc. Potassium	meq/100g	0.9	1.1	1.46	1.95	1.97
Exc. Sodium	meq/100g	0.35	1.85	3.88	6.55	7.56
Boron Hot CaCl2	mg/Kg	1.38	4.48	8.17	14.85	14.82
Total Nitrogen	%	0.1	0.03	0.06	0.04	0.05

SYN analysis based on paddock history and organic carbon test

Soil organic N (SON) estimated to be 69 kg N/ha
Residue Organic N (RON) estimated to be 3 kg N/ha
Total N available in soil near sowing 72 kg N/ha
Should have been enough to get around 0.9 t/ha without any further applied N.

Results

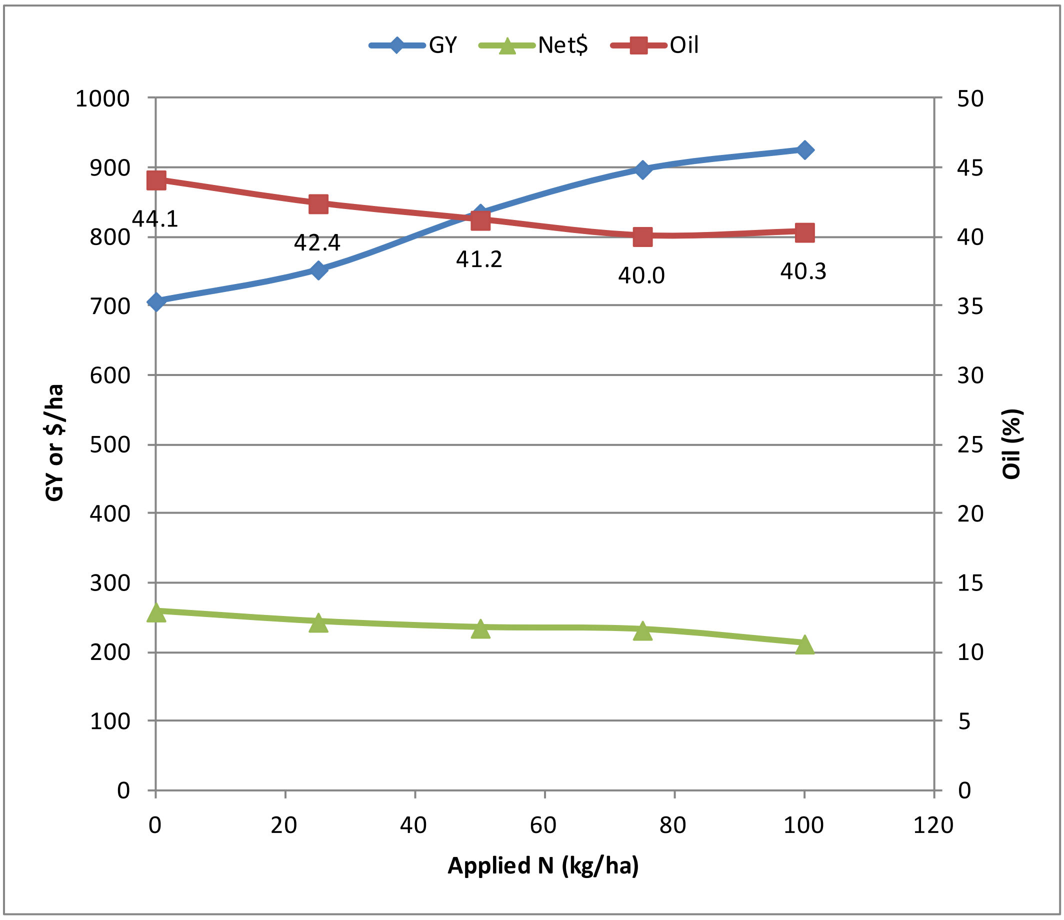

Figure 1 **Mean grain yield (kg/ha), oil (%) and net return (gross margin $/ha) of 6 canola varieties at Grass Patch in 2012.**

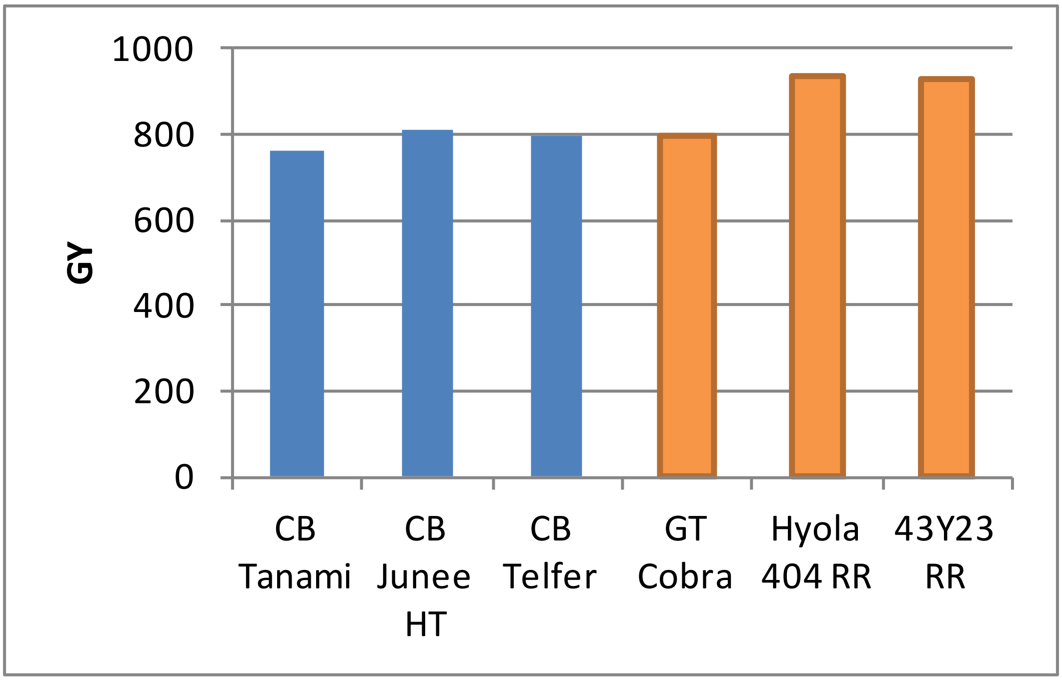

Figure 2 Mean grain yield (kg/ha, averaged over same N rates and time of application) of 6 canola varieties at Grass Patch in 2012. P < 0.001, LSD = 71.

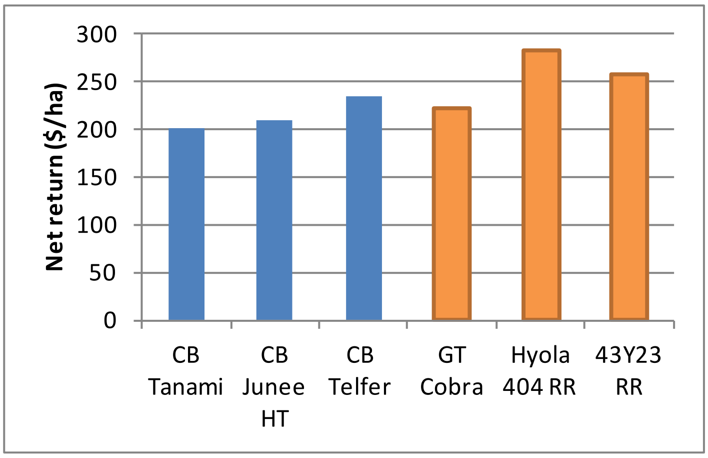

Figure 3 Mean net return ($/ha, averaged over same N rates and time of application) of 6 canola varieties at Grass Patch in 2012. P < 0.001, LSD = 39.

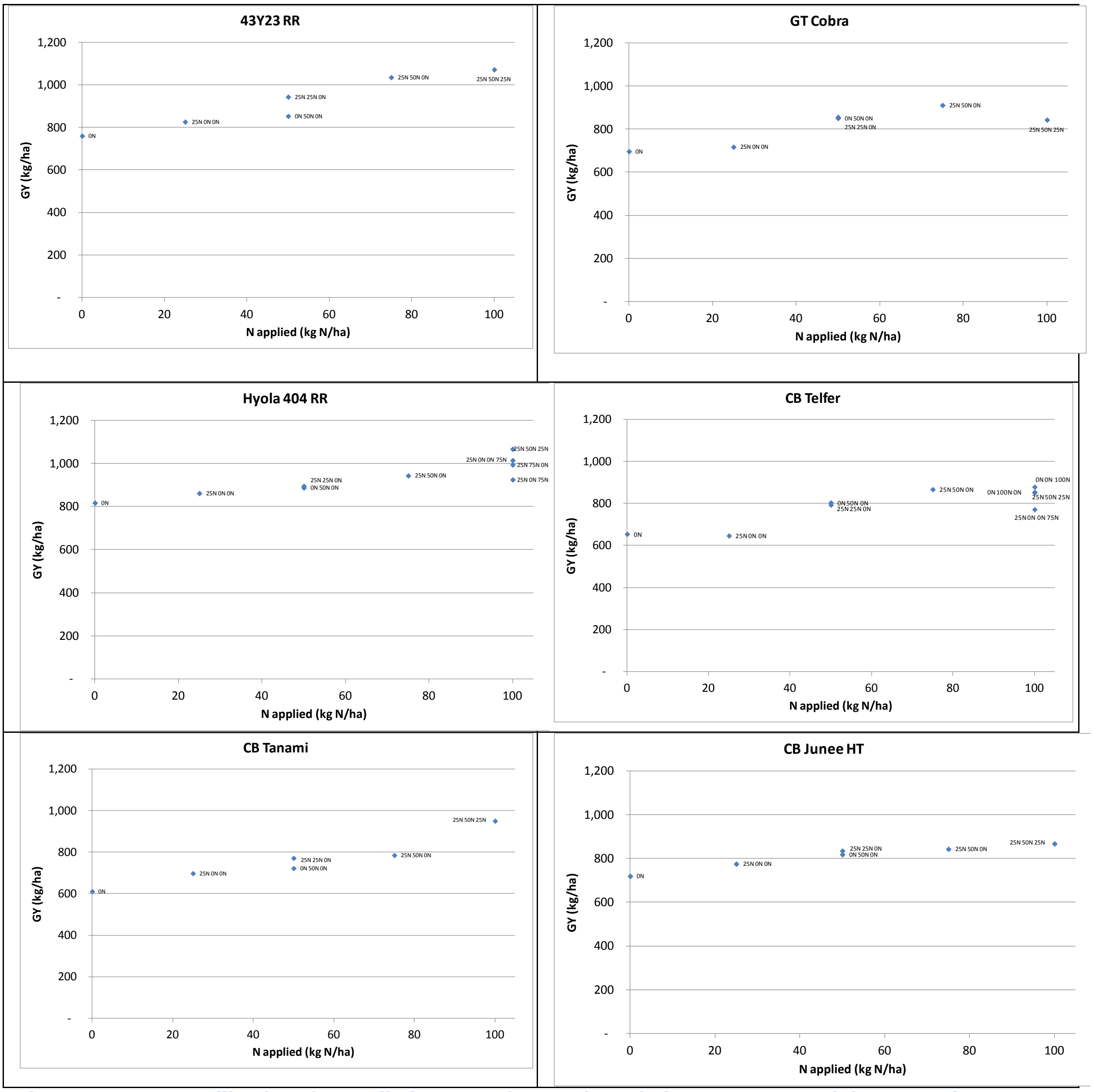

Figure 4 Trellis plot of N applied vs. GY of 6 canola varieties at Grass Patch in 2012. Figures next to symbols indicate timing of N application – either at seeding, 4WAS, 8WAS and/or 12WAS.

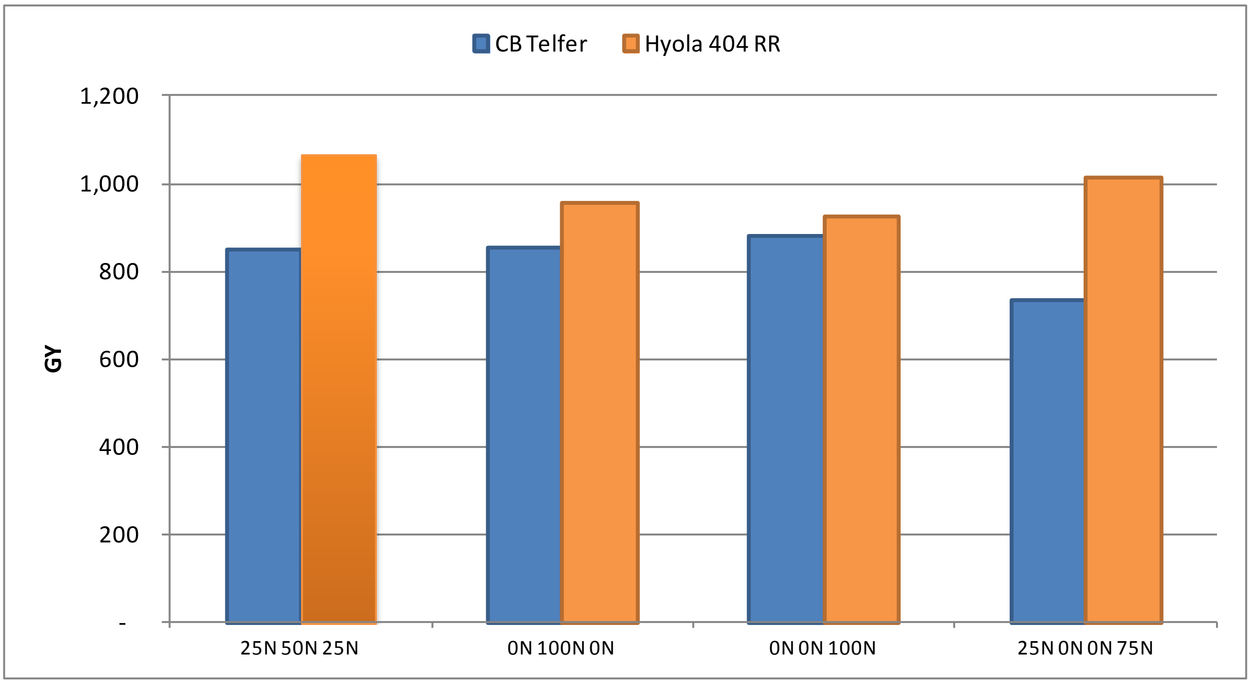

Figure 5 Effect of delaying nitrogen application (split applications totalling 100 kg N/ha applied either at seeding, 4 weeks after sowing [WAS], 8WAS and/or 12 WAS) on the grain yield (kg/ha) of CB Telfer TT and Hyola 404 RR at Grass Patch in 2012. P (Variety*timing) = 0.198 (n.s.).

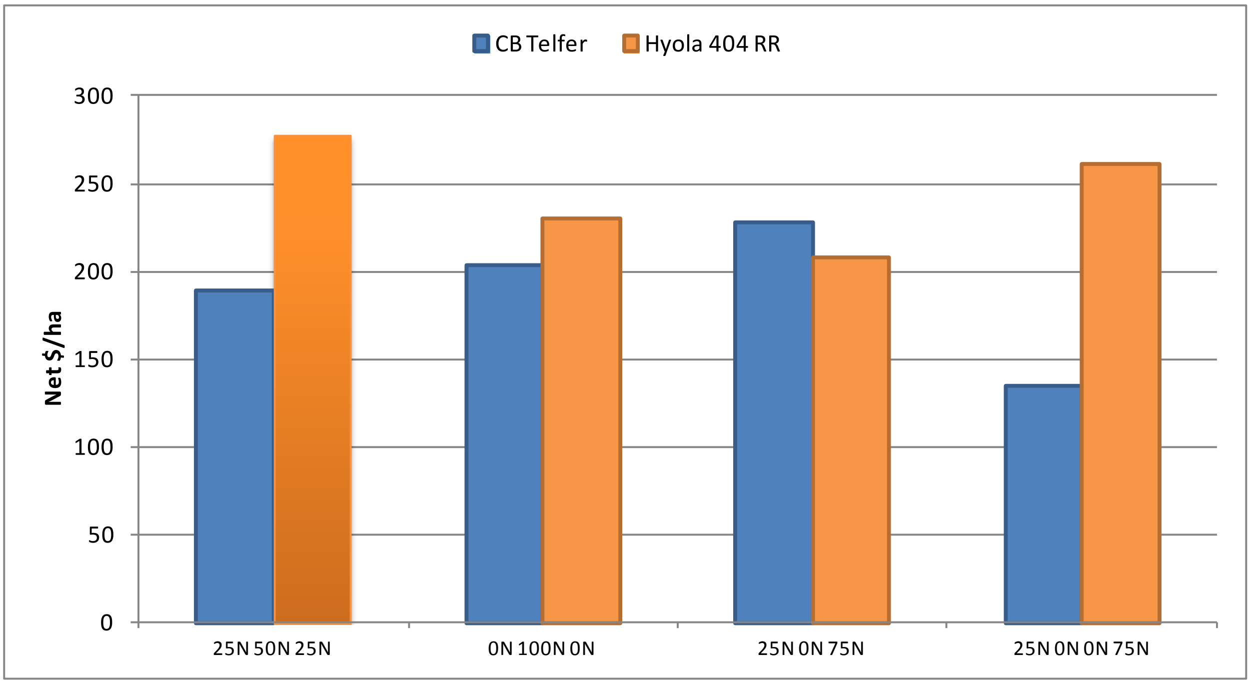

Figure 6 Effect of delaying nitrogen application (split applications totalling 100 kg N/ha applied either at seeding, 4 weeks after sowing [WAS], 8WAS and/or 12 WAS) on the net return (gross margin $/ha) of CB Telfer TT and Hyola 404 RR at Grass Patch in 2012. P (Variety*timing) = 0.225 (n.s.).

Table 2 Grain yield (kg/ha and % of site mean yield), oil (%) and net return (gross margin $/ha and % of site mean) of 6 canola varieties at Grass Patch in 2012.

Variety	N applied	Rate N and timing Seeding/4WAS/8WAS/12WAS	GY	GY%	Oil	Net$	$ % of site
CB Tanami	0	0N	611	73	41.1	210	90
CB Tanami	25	25N 0N 0N	698	83	37.9	212	91
CB Tanami	50	0N 50N 0N	722	86	38.2	179	76
CB Tanami	50	25N 25N 0N	771	92	37.9	204	87
CB Tanami	75	25N 50N 0N	785	93	36.8	175	75
CB Tanami	100	25N 50N 25N	950	113	37.5	225	96
CB Junee HT	0	0N	719	86	43.0	255	109
CB Junee HT	25	25N 0N 0N	775	92	39.8	238	102
CB Junee HT	50	0N 50N 0N	818	97	39.2	209	89
CB Junee HT	50	25N 25N 0N	835	99	39.8	223	95
CB Junee HT	75	25N 50N 0N	843	100	37.9	184	79
CB Junee HT	100	25N 50N 25N	868	103	37.6	147	63
CB Telfer	0	0N	654	78	45.2	260	111
CB Telfer	25	25N 0N 0N	646	77	42.8	212	91
CB Telfer	50	0N 50N 0N	804	96	42.7	257	110
CB Telfer	50	25N 25N 0N	793	94	41.3	241	103
CB Telfer	75	25N 50N 0N	867	103	41.5	257	110
CB Telfer	100	25N 50N 25N	851	101	40.2	189	81
CB Telfer	100	0N 100N 0N	854	102	39.4	204	87
CB Telfer	100	0N 0N 100N	879	105	40.7	228	97
CB Telfer	100	25N 0N 0N 75N	771	92	39.8	159	68
GT Cobra	0	0N	696	83	45.2	249	107
GT Cobra	25	25N 0N 0N	717	85	44.8	230	98
GT Cobra	50	0N 50N 0N	850	101	42.0	240	103
GT Cobra	50	25N 25N 0N	855	102	43.0	250	107
GT Cobra	75	25N 50N 0N	911	108	42.7	251	107
GT Cobra	100	25N 50N 25N	843	100	39.7	141	60
Hyola 404 RR	0	0N	817	97	46.9	315	135
Hyola 404 RR	25	25N 0N 0N	861	103	46.7	311	133
Hyola 404 RR	50	0N 50N 0N	887	106	45.0	265	113
Hyola 404 RR	50	25N 25N 0N	895	107	45.4	273	117
Hyola 404 RR	75	25N 50N 0N	943	112	43.7	260	111
Hyola 404 RR	100	25N 50N 25N	1,067	127	43.0	277	119
Hyola 404 RR	100	25N 75N 0N	994	118	43.0	254	108
Hyola 404 RR	100	25N 0N 75N	925	110	42.4	208	89
Hyola 404 RR	100	25N 0N 0N 75N	1,014	121	42.6	262	112
43Y23 RR	0	0N	760	90	43.0	260	111
43Y23 RR	25	25N 0N 0N	826	98	42.7	267	114
43Y23 RR	50	0N 50N 0N	853	102	40.7	219	94
43Y23 RR	50	25N 25N 0N	944	112	41.6	277	118
43Y23 RR	75	25N 50N 0N	1,035	123	39.9	284	121
43Y23 RR	100	25N 50N 25N	1,072	128	38.9	247	105
Site mean			840		42.0	234	
P			<0.001		<0.001	0.125	
LSD			156	19	1.8	97	41
CV			11		3	26	

Table 3 **Costs and returns used in calculating gross margins. Assumed $100/ha for non treatment costs – insecticides, harvest etc.**

Variety	Seed costs $/kg*	Seed rate kg/ha	Seed costs $/ha	Grain return $/t[A]	EPR $/t	GM discount $/t	Urea S/t[B]	Herbicides
CB Tanami	1.00	1.50	1.50	595.00	5.00	0.00	560.00	46.50[#]
CB Junee HT	25.00	1.46	36.46	600.00	0.00	0.00		46.50
CB Telfer	1.00	1.73	1.73	595.00	5.00	0.00		46.50
GT Cobra	23.00	1.67	38.33	570.00	0.00	30.00		28.20[^]
Hyola 404 RR	30.00	1.89	56.82	570.00	0.00	30.00		28.20
43Y23 RR	30.00	1.71	51.43	570.00	0.00	30.00		28.20

* Includes seed technology fee of $6.85/kg for RR varieties

A Base grain price of $600/t, discounts applied for EPR or GM. Oil bonus of 1.5% +/- either side of 42% oil – no ceiling on oil nonus.

B Application costs of $10/ha for each N application (except seeding time)

2 x 1.1 kg Atrazine/ha + Grass herbicide,

^ Difference between Roundup and Sprayseed at seeding. 2 x 0.9 L Roundup Ready/ha. No grass herbicide.

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Discussion of Results

After a dry April the trial was sown on 30th April immediately after rainfall (recorded May 1). Plants struggled to emerge in dry soil conditions. It was evident RR hybrids handled the dry conditions better than other types. With reasonable June and July rainfall the trial improved and we could apply post emergent fertiliser treatments as planned. The last N treatment was applied on 23rd July close to when most lines began flowering.

Spring rainfall in August and September were about average but October was well below average with only 8 mm falling. Hence crops matured early and harvest was on 29th October.

Average yields were 840 kg/ha with oil around 41%. The highest yield with no applied N was 817 kg/ha (Hyola 404 RR) which was just under what we calculated water limited potential yield (830 kg/ha) and what soil N alone could have produced (900 kg/ha). Despite the dry conditions and the nil treatements reaching potential yield we observed that applied N increased yield but in the dry spring increasing N reduced oil such that applied N led to little economic benefit.

Most farmers in the district grow CB Telfer, which seems to be a wise decision in the TT range. CB Telfer had higher oils and comparable yield than other TT options tested at Grass Patch.

Compared to TT lines and the OP RR line GT Cobra, the RR Hybrids produced the highest yields, oil and returns - particularly Hyola 404RR. As found in 2011, RoundupReady lines out-yielded TT lines and produced higher oil, therefore farmers should keep RR hybrids in their consideration set in low rainfall regions despite higher up front costs.

We included time of nitrogen application in the experiment. We had 4 times of application – sowing, 4WAS, 8WAS and 12WAS all with a total N applied of 100 kg N/ha. Treats were (1) 25N 50N 25N 0N, (2) 0N 100N 0N 0N, (3) 25N 0N 75N 0N and (4) 25N 0N 0N 75N. Overall we found no effect of time of application. There was a tendency for CB Telfer not to respond to the latest application (25N 0N 0N 75N) – perhaps due it being the earliest flowering variety, but this was not significant. This result is worth following up perhaps at lower total rates of N (perhaps 50N) in other years to see if decisions on nitrogen application can be delayed in lower rainfall environments.

Implications

The trial highlights the importance of assessing the nitrogen status and ensuring canola is not over fertilised with nitrogen in low rainfall areas as the reduction of oil with increasing N could lead to large discounts. The trial also points towards opportunities to delay making nitrogen decisions for canola in low rainfall conditions.

The trial confirms previous work that demonstrates that for RR technology the hybrid varieties are currently superior to OP lines for yield and oil, and that the advantages from hybrid RR more than offset higher upfront seed costs.

Hybrid TT as a technology is yet to prove itself compared to CB Telfer in low rainfall areas. With the continued improvement in hybrid TT there is scope for continuing work.

Recommendations

GRDC and DAFWA have developed a 5 year break crop agronomy project which commences in 2013. In this project one of the planned themes will be timing of nitrogen application in canola, therefore we plan to conduct similar experiments to this in future years to provide better management guidelines for farmers in all rainfall zones.

The results of this experiment will be discussed at the Salmon Gums Crop Update in March 2013 and made available to growers via SEPWA newsletter.

Extension

Farmer field walk of trial on 11th of September 2012

Salmon Gums Crop Update in March 2013 Including communication and extension activities, events and attendances

Plain English Summary

Project Title:	**Hybrid Canola Nitrogen Management in low rainfall mallee areas**
GRDC Project No.:	**Regional Cropping Solutions Esperance Zone – Project 1 of 4**
Researcher: Organisation: Phone: Fax: Email:	Mark Seymour DAFWA 0890831111 0890831100 mark.seymour@agric.wa.gov.au
Objectives	To investigate the response of hybrid and Open pollinate Roundup ready and Triazine tolerant canola to nitrogen in the low rainfall zone of WA.
Background	In recent years farmers in Western Australia have extending the area sown to canola into low rainfall zones. Historically canola was not grown in the low rainfall due to the unsuitability of canola varieties. However the development of earlier flowering varieties enables canola to be grown in low rainfall areas. Consequently in the low rainfall zone there is very little farmer, researcher or adviser experience with canola and we are forced to use best bet agronomy brought in from other crops such as wheat and barley or from canola in higher rainfall conditions. Topics of discussion amongst people interested in low rainfall canola are "what variety to grow?, are hybrids worth the risk? How much yield do I lose by using TT canola? What fertiliser regime should I use? And what density should I sow the crop at. This trial tackles 3 of those topics – hybrids vs OP lines, RR vs TT, and N timing and rates.
Research	In 2012 DAFWA conducted a field trial at Grass Patch on the response of hybrid and open pollinated canola varieties to nitrogen rate and timing
Outcomes	In a dry year hybrid RR canola with no applied nitrogen produced the best returns to growers. RR hybrids had higher oil and applying N reduced oil more than it increase yield. With TT technology CB Telfer the most popular variety in the low rainfall area produced the best combination of oil and yield. Hybrid TT was not superior to OP TT's at Grass Patch in 2012. Late applications of N produced similar yield responses to earlier N applications.
Implications	As this was a particularly dry spring with only 8 mm falling in October this type of experiment needs to repeated. However it does open up discussion regarding N rates and oil and timing of N for low rainfall canola growers.
Publications	Salmon Gums Crop Updates 2013.