

Canola Responded to Nitrogen Fertiliser Input across the Dune-Swale at Karoonda in 2016

Therese McBeath¹, Bill Davoren¹, Willie Shoobridge¹, Michael Moodie², Andrew Ware³

¹CSIRO Agriculture and Food, ²Mallee Sustainable Farming, ³South Australian Research and Development Institute

Funding: CSP00187



Key Messages

- Time of nitrogen application was not as important as the quantity available to the plant.
- Nitrogen is an important driver of canola yields across dune-swale soil types and must be managed in the low rainfall zone for the crop to be profitable.

Background

Research and farmer experience have demonstrated the benefits of including canola in the crop rotation, as an effective tool to manage soil borne diseases (particularly Rhizoctonia) and control grass weeds. Cereal crops following canola in the low rainfall zone have consistently yielded up to 0.4 t/ha more than maintaining continuous cereal, through reduced root disease and weed burdens. However, many growers in the low rainfall zone have been frustrated by the highly variable profitability of canola as a stand-alone crop. Dry springs, high input costs and episodic pest incursions have impacted the profitability of canola over the past five years. If canola is to be a sustainable, long-term break crop option in low rainfall areas, growers require low risk management systems.

Trials conducted from 2013-2015 have indicated that time of sowing has had a far greater impact on canola productivity than establishment number, sowing depth and variety choice.

Table 1. Average canola yield in response to time of sowing (TOS) in 2013-2015 at Minnipa.

TOS	Dates	Average Yield (t/ha)
1	15-25 April	1.83
2	26 April- 6 May	1.58
3	9-18 May	1.26
4	19-29 May	0.95

Trials at Minnipa and Mildura in 2015 also indicated that canola productivity was best with early N application, and unlike other environments (including Loxton in 2015), waiting until stem elongation for N application resulted in a 10 – 20% a yield penalty.

Following these initial findings, a co-ordinated series of trials at three low rainfall locations (Mildura, Minnipa and Karoonda) were established in 2016 to evaluate options to manage risk in canola crops without yield penalty, such as:

- Delaying nitrogen inputs
- Optimising nitrogen inputs according to soil type and management history.
- Optimising sowing date (while keeping canola at the very beginning of the sowing program)

Here we present the results arising from the experiment based at Karoonda.

About the trial

In 2010-2015 swale, mid-slope, dune-crest and dune soils were treated with nil (0), medium (9 kg N/ha) and high (40 kg N/ha) inputs on wheat crops. In 2016 a range of N fertiliser inputs at different rates and timings were tested on this range of fertiliser N input history (Table 2). All plots received 11 kg P/ha, 6 kg S/ha, 14 kg K/ha and foliar Zn, Cu and Mn to ensure other nutrients were non-limiting.

Pre-sowing soil water and nutrition was measured. In-season plant assessments of establishment, biomass and nutritional status (early flowering) along with grain yield and quality were assessed. Yields are based on machine harvested samples.

Table 2. Treatments of N input history (2010-2015), Fertiliser N rate and Fertiliser N timing for 2016 canola at Karoonda.

N Input History	Fertiliser N (kg N/ha)	Fertiliser N timing
Medium	30	2 leaf ^a
Nil	80	2 leaf
Medium	80	2 leaf
High	80	2 leaf
Medium	30	4-8 leaf ^b
Medium	80	4-8 leaf
High	80	4-8 leaf
Medium	80	Stem elongation ^c

^a2-leaf N applied 7th June, ^b4-8 leaf N applied 8th July, ^cstem elongation N applied 27th July.

Results

Sowing Soil Measurements

The range of soils over which the experiment runs are demonstrated by the range in sowing plant available water (PAW) and mineral N. The sandy over clay mid-slope soil had the most PAW while the sands of the dune-crest and dune had very low levels of PAW at sowing (Table 3). There were also some carryover effects of N input history with the high fertiliser input plots (which were the highest yielding plots in 2015) having a smaller amount of PAW. Profile mineral N was higher for the heavier clay loam swale soil, while there was no effect of N input history on soil mineral N (Table 3). Because the nil N input plots also received nil P input, we also checked the soil Colwell P status. There was no effect of fertiliser input history, and while there were some differences between soil types, all soil types had Colwell P levels in excess of critical values (Table 3).

Table 3. Pre-sowing (5th May) plant available water (PAW), soil mineral N and Colwell extractable P for the 2016 canola plots at Karoonda.

Soil	PAW (mm/m)	Mineral N (kg/ha/m)	Colwell P* (mg/kg)
Swale	90b	116a	34a
Mid-slope	114a	62b	22b
Dune-	12d	62b	32a
Dune	41c	40b	20b
Stats	LSD=23	LSD=32	LSD=5
N input			
Nil	74a	69	25
Medium	66ab	75	30
High	52b	73	26
Stats (P=0.05)	LSD=16	NSD	NSD

*Using PBI, critical Colwell P (mg/kg) values are estimated at swale=20, mid-slope=14, dune-crest=12, dune=11. LSD= least significant difference, NSD= no significant difference.

In-crop Measurements

Stingray canola was sown at 3 kg/ha on 10th May into relatively dry soil conditions particularly on the sandy dune soils, with only 6mm of rainfall falling for the month prior to a 35mm event from the 25th-27th May. Soil type had a significant effect on establishment, while the effect of fertiliser input was not significant (Table 4). The low plant numbers on the sandier soil types (Dune-crest and Dune) reflect one of the key risks of the production of canola on low rainfall sands, particularly when the sand is water repellent.

Table 4. Canola establishment (plants/m²), flowering biomass (t/ha), grain yield (t/ha) and grain oil (%). Within a soil type a treatment mean annotated by a different letter is significantly different at P=0.05.

trt	N Input History	Fertiliser N (kg N/ha)	Fertiliser N timing	Establishment (plants/m ²)	Flowering Biomass (t/ha)	Grain Yield (t/ha)	Grain Oil (% w/w)
Swale				58a	2.85	2.63	46.6
3	Medium	30	2 leaf		2.72	2.26d	47.43a
4	Nil	80	2 leaf		3.36	2.54c	46.65ab
1	Medium	80	2 leaf		3.11	2.62bc	46.85a
5	High	80	2 leaf		2.81	2.83b	45.65c
8	Medium	30	4-8 leaf		2.58	2.23d	47.00a
2	Medium	80	4-8 leaf		3.01	2.85ab	46.73ab
6	High	80	4-8 leaf		2.76	2.88a	45.98bc
7	Medium	80	Stem Elong		2.47	2.80ab	46.55abc
Mid-slope				49b	2.78	2.26	48.16
3	Medium	30	2 leaf		2.64	2.19c	48.45
4	Nil	80	2 leaf		3.07	2.47ab	48.2
1	Medium	80	2 leaf		3.29	2.48ab	48.1
5	High	80	2 leaf		2.81	2.29bc	48.03
8	Medium	30	4-8 leaf		2.39	1.83d	48.05
2	Medium	80	4-8 leaf		2.79	2.41abc	48.15
6	High	80	4-8 leaf		2.71	2.29bc	48.33
7	Medium	80	Stem Elong		2.55	2.55a	48
Dune-Crest				16c	0.47	1.38	45.78
3	Medium	30	2 leaf		0.29	0.82e	46.58
4	Nil	80	2 leaf		0.73	1.43bc	46.23
1	Medium	80	2 leaf		0.62	1.74a	45.43
5	High	80	2 leaf		0.27	1.01de	44.2
8	Medium	30	4-8 leaf		0.78	1.16cd	46.47
2	Medium	80	4-8 leaf		0.27	1.58ab	45.63
6	High	80	4-8 leaf		0.33	1.61ab	45.35
7	Medium	80	Stem Elong		0.45	1.68ab	46.7
Dune				14c	0.57	1.38	45.93
3	Medium	30	2 leaf		0.54	1.06c	45.65
4	Nil	80	2 leaf		0.64	1.63ab	45.68
1	Medium	80	2 leaf		0.91	1.62ab	46.15
5	High	80	2 leaf		0.23	0.92c	45.23
8	Medium	30	4-8 leaf		0.72	1.02c	46.55
2	Medium	80	4-8 leaf		0.59	1.73a	46
6	High	80	4-8 leaf		0.46	1.69a	45.98
7	Medium	80	Stem Elong		0.49	1.63a	46.2

There were no significant treatment effects on flowering biomass (Table 4). ***For grain yield the dose of N applied as fertiliser had the most significant treatment effect, with 25 -70 % benefit in using 80 kg N/ha compared with 30 kg N/ha.*** This includes a significant (25%) canola yield response to N dose even on the heavier soil type (swale) on which wheat did not respond to N fertiliser (Table 4). Pre-sowing mineral N was the same within a soil type despite different N addition histories, limiting the effect of N history (Table 3).

Despite six years of nil fertiliser history, plots were able to produce the same canola yield as plots with differing N history when fertilised with 80 kg N/ha. However, the high N history treatment had very low canola yields on sand, even with the high dose of N fertiliser. This was the highest yielding treatment in the six years of wheat before that. Checks have been made to ensure that other nutrients were not limiting, but the effect of this treatment on N supply potential (organic N supply) has not been evaluated to date.

Timing of N application didn't appear to be important for the 2016 growing season which was a dry, slow start and cool, wet finish (Table 4). All oil % was above 40%. The only soil on which treatment had a significant effect on oil % was the swale with the higher yielding treatments having a lower oil % by approximately 1% (Table 4).

Acknowledgements

We thank the Loller family (Lowaldie/Karoonda) for hosting the field site. Thanks to Navneet Aggarwal for technical assistance. Thanks to Jeff Braun and Lou Flohr for discussions around trial design. This work is a component of the 'Optimised Canola Profitability' project (CSP00187) a collaboration between NSW DPI, CSIRO and GRDC in partnership with SARDI, CSU, MSF and BCG.

