2017

Managing the Risk of Canola Production in Low Rainfall Environments

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Key Messages

- Sowing at the earliest opportunity (which requires rainfall) is an important component of reducing the risk of canola production in low rainfall environments.
- The amount of N available to the crop is critical to productivity in a canola crop that has established well.
- Applying adequate doses of fertiliser N at seeding or early in the crop's development have produced the highest grain yields but this was less important in a wet spring like 2016.
- Legumes can provide N to a subsequent canola crop, but in many cases, canola growing on legume residue will still respond to fertiliser N inputs.
- Analysis of the profit-risk context for optimal N inputs for canola produced in low rainfall environments is underway.

Background

In 2015 a co-ordinated series of trials at three low rainfall locations (Mildura, Minnipa and Loxton) were established to evaluate options to manage risk in canola crops without yield penalty. The treatments included a range of sowing dates, hybrid (Hyola 450) vs TT (Stingray) cultivar comparisons, N fertiliser timings and N fertiliser rates with the aim to improve the reliability of canola establishment, optimise sowing date (while keeping canola at the very beginning of the sowing program), quantify the cost/benefit of hybrid varieties and identify optimal timing for N inputs. Experiments in 2015 indicated that sowing at the earliest opportunity, in this case a break of season sowing in April, offered the best yield outcome. Yield gains from hybrid canola were small and not economic compared with open pollinated canola. Canola productivity was best with early N application, and in the case of the Mildura site waiting until stem elongation for N application resulted in a 10 – 20% yield penalty (Ware et al. 2017, Moodie et al. 2016).

Experiments in 2016 focussed on N management, given the increased confidence in the key messages around time of sowing and the lack of varietal options obtained from the 2015 experiments. Experiments were established at Ouyen, Minnipa and Karoonda to explore the opportunity and risk associated with N management in low rainfall canola. The treatments included a range of N fertiliser timing, N fertiliser rate, soil type and sowing date to assess whether: different soil types and N management history require different N management, the application of N can be delayed without penalty to yield, higher rates of N provide an economic response and the optimal management of fertilizer N differs depending on sowing date. In 2016 the best sowing date was with a break of season rainfall event in May, and establishment issues associated with dry sowing in April caused a yield penalty. At Karoonda there was a response to N fertiliser on all soil types (at 10 kg grain/kg fertiliser N for all soils at the 80 kg N/ha rate) and the highest yielding treatments were those that received most of their N fertiliser later at stem elongation in a season with a dry start and wet spring. However, consistent across all sites and seasons, time of nitrogen application was not as important as the quantity available to the plant (McBeath et al. 2017). Yield gains from increased N application did not impose an oil content penalty.

In 2017, we established experiments at Minnipa, Mildura and Karoonda 2017 to explore whether sowing canola into legume stubble can reduce N fertiliser requirement and provide a risk management strategy. This approach was taken following the demonstrated importance in 2016 of N supply to canola productivity in low rainfall environments and evidence of an N driven yield gap despite relatively high fertiliser N. The treatments included a range of N fertiliser rates (Karoonda), legume residue types (Mildura and Minnipa) and soil types (Karoonda) to assess whether:

- Legume N reduces fertiliser N requirement in canola
- Soil type affects legume and fertiliser N supply and requirement in canola
- Legume type affects N supply in canola

About the 2017 trials

The experiments included assessments of pre-sowing soil water and mineral N, crop establishment, NDVI, date of 50% start of flowering and biomass and maturity biomass, grain yield and quality.

Minnipa

Canola plots were sown into medic, field pea and wheat residue in May but conditions were extremely dry and the crop did not establish until August. As a result no fertiliser N was applied.

Ouyen

In 2016 plots of barley, field pea, field pea/ barley, vetch/ barley, vetch/ field pea, vetch/ field pea/ barley and vetch were established. Barley and vetch were spraytopped in the Spring in order to brown manure while field peas were grown to maturity. Stingray canola was sown on the 15th May 2017 (resown after failed establishment for April sowing) with 100 kg/ha of single superphosphate. On the 13th July 32 kg N/ha was applied as urea to one half of each plot. There was no follow up rain to incorporate the urea application until the 3rd of August.

Karoonda

At Karoonda plots of lupin and wheat were established in 2016. All plots were sown on the 3rd May 2017 with Stingray canola and received 11 kg P/ha, 11 kg S/ha, 27 kg K/ha and foliar Zn, Cu and Mn to ensure other nutrients were non-limiting. Fertiliser was applied as 50 kg/ha MAP + 1% Zn at sowing (5kg N) and any additional fertiliser was applied after the crop emerged at 2-4 leaves by top dressing with Urea (at 30 or 80 kg N/ha) on the 21st of June.

2017 Trials Results & Discussion

Minnipa

Given the very late establishment it was surprising that canola yielded 0.3-0.4 t/ha across the residue types, but due to the season there was no significant response to treatments despite a difference in starting N conditions (Table 1).

Table 1. *Pre-sowing Soil Mineral N in response to 2016 crop type at Minnipa.*

2016 crop	Pre-sow soil Mineral N (kg N/ha/m)
Wheat	145
Field Pea	140
Medic	197

Ouyen

Crop residue from the previous crop had a significant effect on canola grain yield (Table 3). The pre-sowing mineral N derived from the crop residue (Table 3) was found to be a primary driver of the canola yield response with a relationship of 13.3 kg grain/ kg pre-sowing Mineral N (R^2=0.9, Figure 1). Canola grain yield also responded to fertiliser N input, but this response was independent of the crop residue type and had a lower efficiency (5.3 kg grain/ kg fertiliser N). There was a 2.5 week gap between the urea application and a rainfall event which may have affected the efficacy. Pre-sowing soil water was not found to affect grain yield (data not shown).

Table 3. *Pre-sowing soil mineral N and canola grain yield (t/ha) in response to 2016 crop type and fertiliser N (32 kg N/ha) addition at Ouyen in 2017.*

	Pre-sow soil Mineral N (kg N/ha/m)	**Grain Yield (t/ha)**
2016 crop		
Barley	39.1	0.79
Field Pea	52.3	1.07
Field Pea/Barley	42.4	0.87
Vetch/Barley	78.5	1.35
Vetch/Field Pea	75.3	1.24
Vetch/Field Pea/Barley	40.3	0.89
Vetch	85.1	1.49
SED (P=0.05)		0.18
Fertiliser	59	
Minus		1.05
Plus		1.22
SED (P=0.05)		0.08

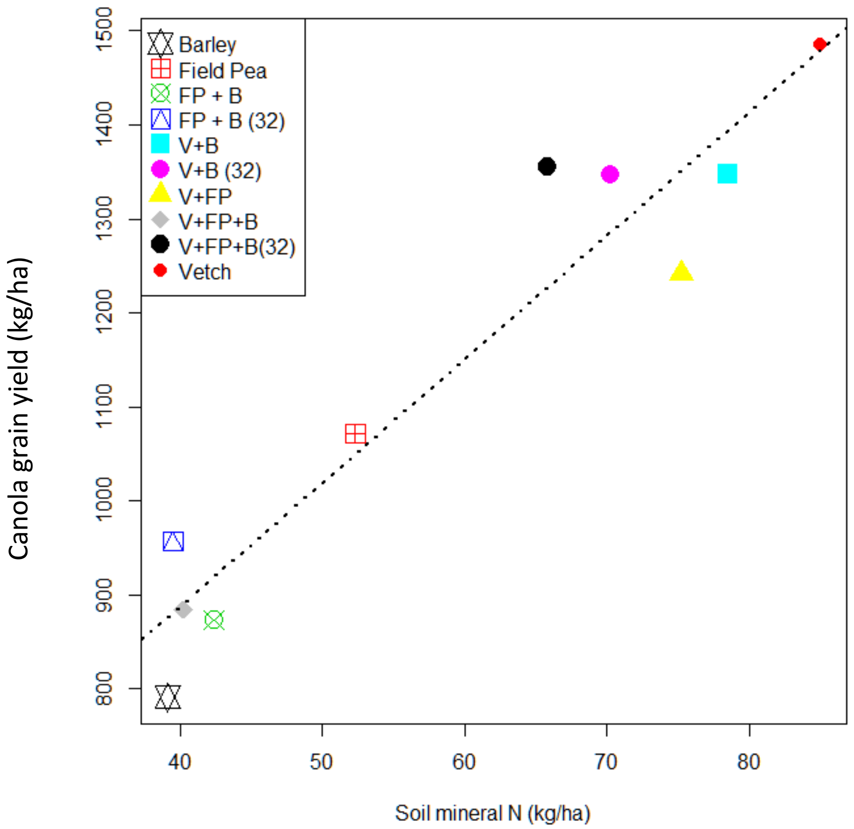

Figure 1. *Relationship between pre-sowing soil mineral N (kg/ha) and grain yield (kg/ha)*

Karoonda

The 2016 lupin crop provided an additional 19-62 kg pre-sowing mineral N/ha depending on the soil type with the greatest benefit on the swale. However, there was only a grain yield response to lupin residue compared with wheat on the sandy dune and mid-slope soils with a 40-60% yield benefit and as a result soil mineral N and canola grain yield were not directly related at the Karoonda site (Table 4). The grain yield benefit did not directly relate to pre-sowing mineral N or the change in mineral N provided by the legume (e.g. the canola on the swale had the highest mineral N boost from the legume but there was no yield benefit of legume vs wheat). Residue type did not interact with fertiliser N input for grain yield response. Both of the sands showed significant yield benefit at the 80kg N/ha input level compared with 5 kg N/ha. There was a wide variation in the extra grain produced from this 75 kg N/ha supplied as fertiliser with 4.4-10.6 kg grain/ kg fertiliser N. Canola oil content was not affected by treatment and varied from 44.12-47.62%. There was a tendency for oil content to be higher in higher yielding plots.

Table 4. *Canola grain yield*(t/ha) on Karoonda dune, mid-slope and swale soils in response to residue type (wheat and lupins) and N fertiliser input (5,30 and 80 kg N/ha).*

	Soil Type		
	Dune	Mid-slope	Swale
Residue Type			
Wheat	0.79	0.70	**0.78**
Lupins	1.29	0.98	0.86
LSD, P=0.05	0.11	0.09	NSD
Fertiliser N rate (kg N/ha)			
5	0.70	0.74	0.79
30	0.92	0.71	0.79
80	**1.50**	**1.07**	0.88
LSD, P=0.05	0.24	0.11	NSD

* Note that there was a significant hailstorm two days before the plots were hand-harvested. Assessments indicated that different treatments did not have different levels of hail damage within a soil type, canola on sands had approximately 60% pod loss while canola on the swale had approximately 38% pod loss.

Implications for commercial practice

For crops that had sufficient surface soil water to establish in 2017, N availability was a key driver of yield on the sandy soil types. Extra pre-sowing mineral N derived from legume residues proved directly beneficial to canola yield. In addition fertiliser N provided yield gains. The lack of interaction between residue and fertiliser N demonstrates the responsiveness of canola on sands to extra N in the system because even with extra N from residue, canola responded to fertiliser N inputs. This is consistent with our findings on wheat crops produced on Mallee sands. Further work to explore the profit-risk trade-offs is needed to arrive at the optimal level of N input for canola in the low rainfall environment. Recent data suggests that there are new varieties that may prove higher yielding than Stingray in low rainfall environments and testing their fit and N requirement together is likely beneficial.

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