Taking South Australian canola profitability to the next level

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Location
Yeltukka (15 km NW Cummins)
Michael Treloar
Rainfall
Av. Annual: 396 mm
Av. GSR: 315 mm
2020 Total: 431 mm
2020 GSR: 365 mm
2021 Total: 421 mm
2021 GSR: 377 mm
Yield
Potential: Canola 5.3 t/ha (Modified French/Schultz, 14 kg/mm)
Actual: 3.5 t/ha
Paddock history
2021: Canola
2020: Wheat
2019: Lupins
Soil type
Sand over clay loam with some calcrete in sub-soil
Soil test
Yeltukka 0-10 cm pH 6.25

Location
Coomunga (15 km NW Port Lincoln)
Peter Russell
Rainfall
Av. Annual: 616 mm
Av. GSR: 499 mm
2020 Total: 881 mm
2020 GSR: 563 mm
2021 Total: 700 mm
2021 GSR: 554 mm
Yield
Potential: Canola 7.7 t/ha (Modified French/Schultz, 14 kg/mm)
Actual: 3.9 t/ha
Paddock history
2021: Canola
2020: Lupins
2019: Wheat
Soil type
Sand loam over ironstone clay loam
Soil test
Coomunga 0-10 cm pH 5.3

Plot size
10 m x 2 m x 4 reps
Split plot x completely randomised block
Yield limiting factors
Some broadleaf weeds in Yeltukka trial

Key messages

- **High canola yields (3.5 t/ha+) were achieved at two sites on the lower EP in 2021.**
- **Canola yields were not improved by applying higher rates of nitrogen, phosphorous, or trace elements than considered "district practice".**
- **At the two 2021 sites canola yields were similar following a 2020 wheat crop as they were for a 2020 lupin or faba bean crop.**

Why do the trial?

Practices such as early sowing, matching cultivar phenology and sowing time to critical flowering period, the use of higher rates of nitrogen fertiliser, the development of high yielding hybrid varieties and fungicide use to control blackleg have improved canola yield in recent years.

To gain insight to where the next advance in canola yield may come from and to determine if profitability can also be improved, a series of trials were commenced in a set-up phase in 2020 and then were planted to canola in 2021.

How was it done?

The trials are being run over two growing seasons at two sites on the lower Eyre Peninsula.

- Site 1: Coomunga (15 km NW Port Lincoln) on an ironstone duplex loamy sand soil.
- Site 2: Yeltukka (15 km NW Cummins) on a sand over clay loam soil.

In 2020 blocks of wheat and lupins (Coomunga) and wheat and faba beans (Yeltukka) were grown in preparation for canola in 2021. On each block separate treatments of high rates of nitrogen, phosphorous, sulphur, and trace elements were applied to create differences for the canola to be grown into in 2021.

In 2021 Pioneer 44Y94CL canola treated with Saltro® seed dressing was seeded dry (16 May Coomunga, 19 May Yeltukka) at both sites, targeting establishment of 45 plants/m^2. Germinating rains fell on 24 May.

In 2021 each site was sown with 100 kg/ha MAP + 200 mL/ha flutriafol 500. A total of 148 kg/ha N (district practice) was applied to the sites before early flowering. Weeds were controlled with 1 L/ha propyzamide, 500 mL/ha of clethodim, and 50 mL/ha Lontrel Advance. 600 mL/ha Aviator Xpro was applied at 30% bloom to control upper canopy blackleg. 500 mL/ha Pyrinex Super was applied post-sowing and 100 mL/ha alpha-cypermethrin applied during grain fill to prevent insect damage.

Additional nutrition was applied as detailed in Table 1 to raise levels of individual nutrients.

Harvest was conducted on 2 November at Yeltukka and 11 November at Coomunga.

Phosphorous was applied at high rate during seeding 2020, nitrogen was applied as urea during stem elongation 2020.

Table 1. Rates (kg/ha) of nitrogen, phosphorous and sulphur applied to each treatment in 2020 and 2021 at both Coomunga and Yeltukka.

		District Practice	P high	N High	TE High	Everything high
Nitrogen (N)	2020	9 (+125)*	9 (+125)	159 (+125)	9 (+125)	159 (+125)
	2021	148	148	148	148	148
	Total	157 (+125)	157 (+125)	307 (+125)	157 (+125)	307 (+125)
Phosphorus (P)	2020	18	36	18	18	36
	2021	22	22	22	22	22
	Total	40	58	40	40	58

*() figure = extra nitrogen (kg/ha) applied to all wheat plots in 2020. Lupin/ faba bean plots did not receive this.

Table 2. Results of pre-seeding soil tests taken at Coomunga 2021.

2020 Treatment	Total Mineral N (kg/ha) Depth 0-100cm	Total PAW (mm) Depth 0-100cm	S (kg/ha) Depth 0-100 cm	Colwell P (mg/kg) Depth 0-10cm
Wheat - Everything	156	53	89	23
Wheat - District Practice	91	22	94	26
Lupins - Everything	158	25	76	21
Lupins - District Practice	101	44	82	26

Table 3. Grain yield of canola 2021 at Coomunga following the different 2020 crops.

2020 Crop	Yield (t/ha)
Lupin	3.88
Wheat	3.82
LSD (P=0.05)	*ns*

Table 4. Grain yield and oil content of canola 2021 at Coomunga as a result of treatments applied in both 2020 and 2021.

Treatment	Yield (t/ha)	Oil (%)
District Practice	3.75	44.4
P High	3.82	44.9
N High	3.82	44.4
TE High	3.91	45.3
Everything High	3.98	45.0
CV	*9.80*	
LSD (P=0.05)	*ns*	*ns*

Table 5. Results of pre-seeding soil tests taken at Yeltukka 2021.

2020 Treatment	Total Mineral N (kg/ha) Depth 0-100 cm	Total PAW (mm) Depth 0-100 cm	S (kg/ha) Depth 0-100 cm	Colwell P (mg/kg) Depth 0-10 cm
Wheat - Everything	142	82	112	25
Wheat - District Practice	46	108	183	24
Lupins - Everything	128	178	417	27
Lupins - District Practice	80	168	390	36

Table 6. Grain yield of canola 2021 at Yeltukka following the different 2020 crops.

2020 Crop	Yield (t/ha)
Faba Bean	3.53
Wheat	3.55
LSD (P=0.05)	*ns*

Table 7. Grain yield and oil content of canola 2021 at Coomunga as a result of treatments applied in both 2020 and 2021.

Treatment	Yield (t/ha)	Oil (%)
District Practice	3.45	43.4
P High	3.49	42.8
N High	3.58	43.0
TE High	3.58	43.1
Everything High	3.58	42.8
CV	*8.8*	
LSD (P=0.05)	*ns*	*ns*

The "Trace Element (TE) High" and "Everything High" treatments also received 1.7 kg/ha Zn, 5 kg/ha Ca, 2.6 kg/ha Mn, 1 kg/ha Cu, 40 g/ha B, 2 g/ha Mo, and 1.35 kg/ha Fe in 2020, through streaming nozzles. This treatment also received 120 g/ha Zn, 150 g/ha Mn, 40 g/ha Cu, 50 g/ha Ca and 6 g/ha Mo applied as a foliar spray at early bloom in 2021.

Yields presented are hand cut yields, collected at 60% seed colour, as this represents the most accurate method of determining canola yield in small plot trials (John Kirkegaard, pers. comm.).

What happened?

Site 1: Coomunga

2020 Results: Sown 12 May. Wheat (cv Scepter) yielded 5.0 t/ha, lupins (cv Wonga) yielded 1.8 t/ha.

Site 2: Yeltukka

2020 Results: Sown 13 May. Wheat (cv Scepter) yielded 5.3 t/ha, Faba beans (cv Fiesta) yielded 3.1 t/ha.

What does this mean?

Immediately following harvest in 2020, plant available soil moisture levels were 20 mm higher following lupins than wheat at Coomunga. These differences had eroded by April 2021 (where 150 mm of rain fell between December and April).

At Yeltukka differences in plant available water following faba beans compared to wheat found at harvest remained at seeding, with soil moisture levels 80 mm higher to a depth of one metre where faba beans had been grown compared to wheat (84 mm of rain was recorded between December and April at Yeltukka).

This indicates that pulse crops may leave potentially valuable soil water for the next crop to utilise. However, with 170 mm falling during June and July 2021 at Yeltukka and 310 mm falling in the same period at Coomunga, soil moisture profiles filled to capacity at both sites by the end of July, before the crop was able to utilise any stored water (a soil moisture probe is located in the same paddock as the Yeltukka trial).

The faba bean crop at Yeltukka left higher (40 kg/ha) mineral nitrogen levels prior to seeding 2021 than wheat. There was no difference in the amount of mineral nitrogen measured in April 2021 following a lupin crop compared to wheat at Coomunga. The differences didn't realise extra grain grown as a result in 2021.

There was no advantage in growing a pulse crop compared to wheat at either site.

Where 150 kg/ha of extra nitrogen was added (N High and Everything High treatments) during stem elongation in 2020, higher soil mineral N levels were measured prior to seeding at both sites in 2021. This indicates that the concept of nitrogen banking, through banking nitrogen in one year, to be used in subsequent years has some potential. However, in these instances the extra nitrogen provided no increase in canola grain yield at either site.

Canola has been shown to require around 80 kg of nitrogen per tonne of grain removed. To achieve the average yields at each site (3.54 t/ha at Yeltukka and 3.86 t/ha at Coomunga) 283 kg/ha and 309 kg/ha respectively of nitrogen was required at each site.

The treatment starting with the lowest nitrogen levels at Yeltukka (2020 Wheat - District Practice) started the 2021 season with 46 kg/ha nitrogen. 148 kg/ha of nitrogen was added to the canola crop in 2021. The canola grown on the 2020 wheat - district practice treatment realised a yield of 3.45 t/ha which meant the crop required an extra 82 kg/ha of nitrogen to be released from soil mineralisation.

For this amount to be released is historically higher than normal. This may have been due to favourable conditions in October.

Similarly on the higher rainfall, more gravelly type soil at Coomunga, where nitrogen is thought to leech and denitrify in wet conditions an extra 61 kg/ha of nitrogen may have been mineralised for the canola grown on 2020 wheat - district practice treatment to yield 3.75 t/ha.

Higher nitrogen rates applied in the year prior did not affect canola oil percentages at Yeltukka and Coomunga.

Adding higher levels of phosphorous (P) to each site in the year prior to growing canola was thought to boost levels of P sufficiently so it is not limiting when aiming to grow a canola high yielding crop. Canola typically removes 7 kg/t of grain, with many Eyre Peninsula soils (such as the ironstone and calcareous soil these trials were conducted on) also tying P up in insoluble compounds. If targeted yields of canola are higher than 3 t/ha then 100 kg/ha of MAP or DAP are not going to satisfy the total P requirement. Canola is also very sensitive to having high rates of fertiliser close to seed, where germination may be affected. As such, applying all of a crop's requirements in the year it is grown may not be possible.

In both 2021 trials there was no response to adding higher (38 kg/ha of P) the year prior to grain yield.

Canola is typically more efficient at finding sufficient trace elements in soils than cereal crops, however some anecdotal evidence suggests applying trace elements, not only to vegetative crops, but also to crops starting flowering may improve yields in some situations. To investigate this, high rates of trace elements were applied in 2020 including zinc, calcium, manganese, copper, boron, molybdenum and iron. These plots also received zinc, manganese, copper, calcium, boron and molybdenum as a foliar application during early bloom 2021. These treatments did not improve canola grain yield in 2021.

While the treatments used in these trials did not have any influence on canola grain yield in 2021, the trial has given insights into the amount of soil water left by different crops in the lower Eyre Peninsula environment, the amount of nitrogen mineralised in 2021 and how that may have had a large influence on grain yield across the region, how loading high rates of P the year prior may not have an effect on the subsequent crop and how the application of trace elements at these two sites did not affect grain yield.

Achieving canola yields in excess of 3.5 t/ha with above average growing season rainfall on the lower Eyre Peninsula is considered reasonable in light of historical yields but this represents a water use efficiency of 9 kg/mm, well short of the 14 kg/mm thought to be the theoretical potential. These trials do not answer how much later than ideal break to the season and the dry September that coincided with the critical period when canola is most prone to heat, frost and drought damage affected canola yield in 2021. However, choosing a high yielding variety, planting as close as possible to the ideal sowing window, having adequate nutrition and managing blackleg were still important in helping to drive high canola yields on the lower Eyre Peninsula in 2021.

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