17. High Inputs, High Yield

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KEY MESSAGES

- National GRDC funded project 'Optimising the yield and economic potential of high input cropping systems in the high rainfall zone'.
- Two nutrient omission trials sown in 2016 at Bool Lagoon to test canola and wheat yield response and the interactions between nutrients where N, P, K and S and micro-nutrients Zn and Cu are omitted.
- Relative to the treatment supplied with non-limiting nutrients, both canola and wheat grain yields were significantly lower if either P or S were not applied at sowing (38 and 30 % depression respectively for canola, 24% and 17% for wheat).
- Relative to the treatment supplied with non-limiting nutrients, canola biomass at flowering was 36 % lower without in-crop N and 8% lower without P at sowing, while wheat biomass at flowering was 40% lower without in-crop N and 12% lower without P at sowing.

The MFMG is a collaborator in the national GRDC funded project 'Optimising the yield and economic potential of high input cropping systems in the high rainfall zone' (DAV00141). The project is led by DEDJTR in Hamilton, Victoria and managed by the SARDI team at Struan.

A component of this national project is 'Managing High Input Systems'. This component has involved the establishment and management of two Omission Trials at Bool Lagoon in 2016.

Trial Background

Canola and wheat grown in the HRZ of South Australia and Victoria can potentially produce grain yields over 4 and 8 t/ha, respectively. However, the average in this region tends to be less than half these values. Such high yielding crops require a substantial application of inputs, the most expensive being fertiliser. Decisions about nitrogen fertiliser rates are generally based on the difference between the nutrients required for a targeted yield and the estimated amount of nutrients supplied to the soil. However, limited research has been conducted in the HRZ relating the nutrient response of crops to soil nutrient status, and critical soil test values have been derived from regions with lower yield potential. An improved understanding of this relationship will reduce the risk of either under or over applying fertilisers, hence maximizing returns to growers.

The project aims (i) to collect field data that can be pooled with existing data from the Better Fertiliser Decisions for Crops database (BFDC) to assess the applicability of recommended soil critical values for the HRZ of southern Australia, (ii) quantify the effects of nutrient deficiencies on grain yield, and (iii) identify the main nutrients limiting grain yield for the purpose of conducting rate experiments in subsequent years.

2014 Region Surveys: An on-ground survey was conducted in the region to assess the status of the major and trace elements in soils and crops. Selected paddocks across the region were soil sampled, followed by tissue sample of the sown crop and then subsequent grain quality. Results from soil and plant (tissue and grain) analyses were compared to established critical values to determine if there were common deficiencies. These data will be added into the current technical document 'Crop Nutrient Decisions in the High Rainfall Zone' (access online http://www.mackillopgroup.com.au/media/HRZ%20crop%20nutrition%20report/HRZ_CropNutritionReport160930.pdf) which provides a situation analysis of the soil nutrient status across the HRZ of Southern Australia.

2015 Omission Trials: 'Omission' experiments were designed to test crop yield response and the interactions between nutrients where N, P, K and S plus the micro-nutrients (Micro) Zn and Cu are omitted. A wheat omission trial (Bool Lagoon) and a canola omission trial (Frances) were established in 2015. At both sites the only significant response observed was between the N application rates. Due to the exceptionally dry conditions yields were well below regional long-term averages and the results suggest that yields can be obtained on low nutrients in dry seasons. Complete trial results are presented in the MFMG 2015 Annual results book.

Trial Design

Replicating the trials from 2015, two nutrient omission trials were established at Bool Lagoon. Again the experiments were designed to test crop yield response and the interactions between nutrients where N, P, K and S plus the micro-nutrients (Micro) Zn and Cu are omitted. Initial soil test values at the site were 24 mg/kg Colwell P, 1150 mg/kg Colwell K, 6.7 mg/kg extractable S and 35 kg/ha mineral N in the top 15 cm of the soil profile, below which was limestone. At these soil test values, a small response (5-15%) would be expected to P and S, a strong response to N and no response to K. Figure Table 1 lists the treatments, with nitrogen % yield potential and nutrients applied.

Table 2 details the nutrient amounts applied at sowing and Table 3 and Table 4 detail the amount of nitrogen applied based on a 100 %, 60 % and 30 % yield potential. The Bool Lagoon site was selected as a N and P responsive site and the rates were calibrated based on pre-seeding soil analysis results and crop type.

On 20 May Archer canola was sown with an aim of 60 plants/m2 and Beaufort wheat was sown with an aim of 180 plants/m2.

Table 1. Omission Trial Treatments, Nitrogen Yield Potential and Nutrient Treatments.

Nitrogen Yield Potential	Nutrient Treatments	Omitted nutrients
30 % Yield Potential	PKS + Micro	N
30 % Yield Potential	Nil	N, P, K, S, Micro
60 % Yield Potential	PKS + Micro	N
60 % Yield Potential	Nil	N, P, K, S, Micro
60 % Yield Potential	PKS	N, Micro
60 % Yield Potential	KS + Micro	N, P
60 % Yield Potential	PS + Micro	N, K
60 % Yield Potential	PK + Micro	N, S
100 % Yield Potential	PKS + Micro	-
100 % Yield Potential	Nil	P, K, S, Micro
100 % Yield Potential	PKS	Micro
100 % Yield Potential	KS + Micro	P
100 % Yield Potential	PS + Micro	K
100 % Yield Potential	PK + Micro	S

Table 2. Nutrient rates applied at sowing, same for both Canola and wheat trials.

Nutrient	Applied at Sowing 20 May
Kg P/ha	50
Kg K/ha	50
Kg S/ha	20
Kg Zn/ha	1.1
Kg Cu/ha	2

Table 3. Nitrogen Rates kg N/ha Applied and Dates Applied, Canola Trial.

Date of Application		Nitrogen Treatments		
		100% Yield Potential	60% Yield Potential	30% Yield Potential
20 May – sowing	Kg N/ha applied	30	30	30
29-Aug	Kg N/ha applied	148	80	0
31-Oct	Kg N/ha applied	73	0	0
Total kg N/ha Applied		251	110	30

Table 4. Nitrogen Rates kg N/ha Applied and Dates Applied, Wheat Trial.

Date of Application		Nitrogen Treatments		
		100%	60%	30%
		Yield Potential	Yield Potential	Yield Potential
20 May – sowing	Kg N/ha applied	30	30	30
29-Aug	Kg N/ha applied	94	38	0
31-Oct	Kg N/ha applied	63	0	0
Total kg N/ha Applied		187	68	30

Trial Design

The trials established well but experienced inundation, as such yields are lower than expected and results should be interpreted with caution.

At flowering (canola 19 September and wheat 29 October) plots were sampled for biomass. Sampling at flowering is a standard measurement for crop nutrition experiments. Measurements at this time are used to distinguish between nutrient responses in the vegetative phase compared to those in grain-fill period. Relative to the treatment supplied with non-limiting nutrients (N, P, K, S, Cu and Zn), canola biomass at flowering was 36 % lower without in-crop N and 8% lower without P at sowing, while wheat flowering biomass was 40 % lower without in-crop N and 12% lower without P at sowing.

Despite low canola grain yields (1.41 t/ha for the treatment supplied with non-limiting nutrients) the canola harvest data showed a significant difference at the highest N rate with a significant yield depression if either P or S were not applied (38% for P and 30% for S) (Figure 1). These differences were only significant at the highest rate of N, whereas at the lower N rates targeting 60% and 30% of yield potential, the P and S differences were not statistically significant. If in-crop N was omitted, there was a 41% yield depression.

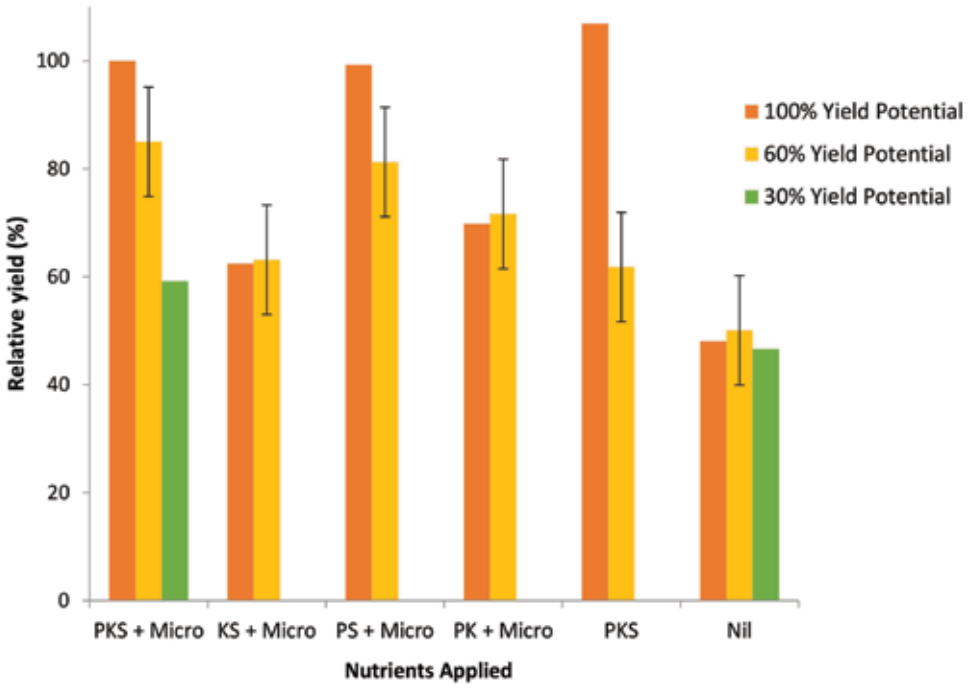

Figure 1. Canola relative yield potential of 100 % yield potential + PKS + Micro (1.41 t/ha).

Wheat grain yields were 4.39 t/ha for the treatment with non-limiting nutrients. There was a depression in yield if P or S were not applied (24% for P, 17% for S). Again these P and S differences were only statistically significant at the highest rate of N, but not the lower N rates (Figure 2). If in-crop N was omitted, there was a 56% yield depression.

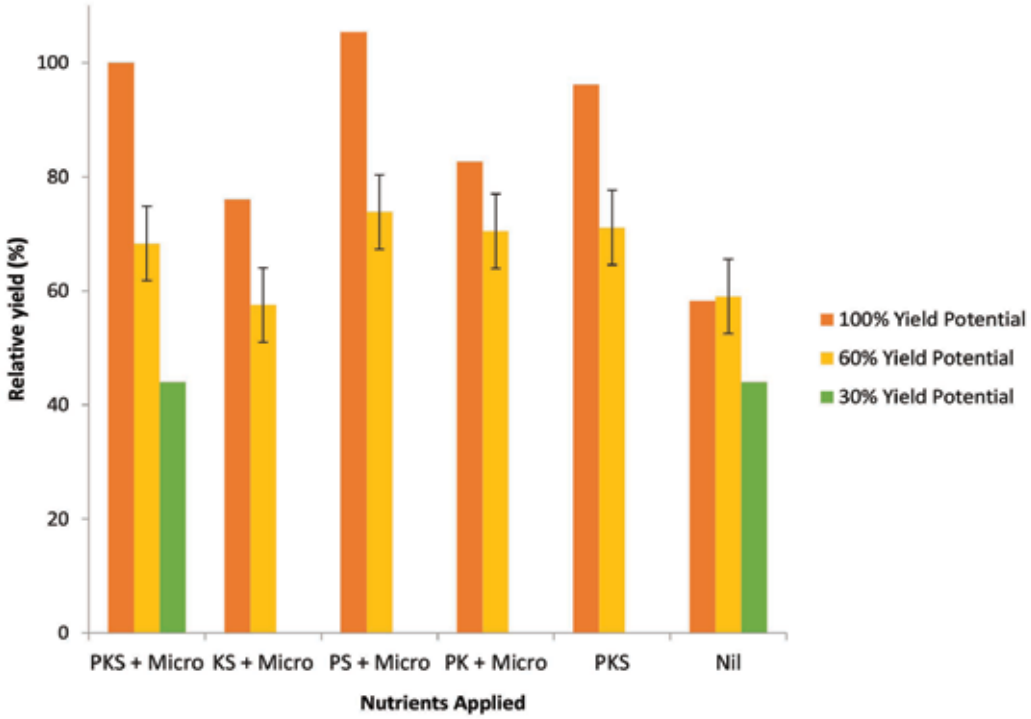

Figure 2. Wheat relative yield potential of 100 % yield potential + PKS + Micro (4.39 t/ha).

Trial Conclusions and Plans for 2017

Even with inundation the trials provided useful data, indicating that N, P and S are the main limiting nutrients at this site, which is typical of many areas of limestone soil in the south-east. The P and S responses only became evident at the highest rate of N. The responses to N and P were evident early in the life of the crop and carried through to grain yield, whereas the response to S became evident between flowering and grain harvest. A similar trial design will be replicated again in 2017, with potentially one trial at Conmurra (wheat) and one trial at Bool Lagoon (canola).

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