Wheat response to N and K

Summit Fertilisers
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AIM

Part of a series of trials to assess wheat response to nitrogen and potassium under different conditions across the wheatbelt and, locally, determine rates to improve yield and returns.

TRIAL DETAILS

Property:	Maroondah Farms, Yealering			
Plot size & replication:	12m x 2 m in 3 randomise replicates			
Soil type:	Sandy duplex			
Crop Variety:	Mace wheat			
Application Date:	At sowing plus split N top-ups post emergence			
Sowing Date:	28 May 2014			
Seeding Rate:	75 kg/ha			
Basal fertiliser (kg/ha):	100 kg/ha TSP (20 kg P/ha) to ensure no P limitation			
Paddock rotation:	Pasture 2013			
Herbicides:	Pre emergent	Trifluralin	2 L/ha	
		Glyphosate	2 L/ha	
		Sakura	188 g/ha	
		Logran	30 g/ha	
	Post emergent	Velocity	1L/ha	(19/08/2014)
		Ally	3g/ha	(19/08/2014)
Insecticides:	Pre emergent	Chlorpyrifos	300 mL/ha	
Fungicides:	Post emergent	Prosaro	300mL/ha	(19/08/2014)

BACKGROUND

During vegetative growth, most plants require equal or greater amounts of potassium (K) than all other nutrients. Adequate K nutrition is essential to ensure efficient recovery and utilisation of other nutrients, particularly nitrogen. Even if the correct recommended rate of nitrogen (N) is applied, if the soil, and therefore the crop is K deficient, the efficient recovery and utilization of the N will be severely impaired.

Potassium research is receiving increased attention in WA due to its role in the ability of crop plants to tolerate stresses such as drought, frost, pests and disease. This trial was designed to test whether wheat growing on soil with low K close to the surface but increasing with depth, would benefit from K application enabling it to make full use of applied N during the crop growth cycle.

Table 1: Soil Test results

	NO_3 N	NH4 N	P	K	S	PBI	pH (CaCl2)	Al	OC%
0-10cm	3	7	19	50	7	25	4.3	2.7	1.2
10-20cm	1	3	11	60	7	30	4.1	4.8	0.5
20-30cm	0	1	4	85	7	42	4.8	0.3	0.25

Table 2: Monthly rainfall data (mm), Yealering. 15 km W of trial site

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Apr-Oct
2014	0	0	0	0.4	35.6	21.2	65.8	46.4	32	49.2	7.8	0.2	250.6
Average	15.4	14.1	19	23.9	47.3	66.1	61.1	49.1	30.5	21.7	14.3	9.6	299.7

METHODOLOGY

- K treatments applied as; MOP at seeding - IBS
- N treatments applied as; Urea 50 kg/ha at seeding – banded, plus
  UAN split at 5 and 8 weeks after seeding – streaming nozzles

RESULTS & DISCUSSION

At 30 July, the crop was showing growth response to both K and N applications (Figure 1). Plant dry biomass was visually lower where no K or N was applied and showed significantly lower and K and nitrate concentrations in the leaves. Plots had only received their second N top-up application one week prior to sampling.

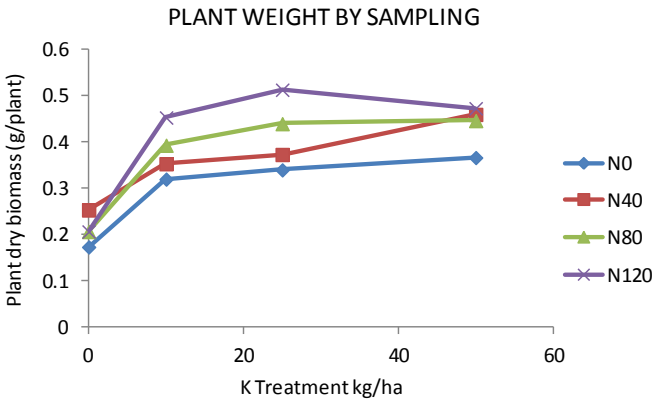

Figure 1: Effect of N and K application rates on mid-season crop growth, 30 July.

By harvest, the response to N was still evident, but the K response had moderated. This may be a result of roots being able to access more K at depth in the duplex soil.

Whilst the number of heads produced was significantly increased by both N and K treatments (Figure 2), grain yield responded significantly only to N, not K. Grain yields ranged from 2.58 T/ha with no N or K applied, to 3.99 T/ha with 80 kg N/ha and 25 kg K/ha.

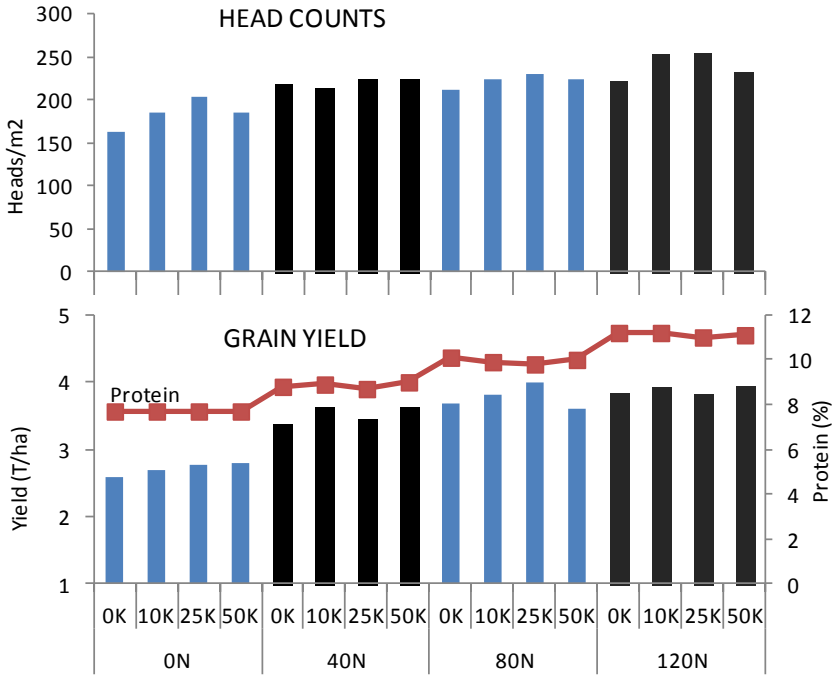

Figure 2: Effect of N and K application rates on crop head density, grain yield and grain protein content.

Summit and others' experience with the Mace wheat variety is that it tends to utilise nutrients, especially nitrogen, in the production of grain yield in preference to grain quality aspects. Certainly yield response to N treatments was evident in this trial. However, increasing N also significantly increased protein resulting in a range of delivery grade qualities from ASW to APW1 (Table 3). If considered individually, a number of the plots at 120 kg N/ha would have met the H2 grade with protein above 11.5%. While grade premiums are worth some consideration, yield remains the main driver of grower returns. It is worth noting that Mace has the capacity for both yield and quality premiums if supplied good levels of nutrition.

Table 3: Wheat growth, yield and gross margin returns from various N and K application rates.

N	K	Heads/m^2	Yield t/ha	*Protein %	*Weight kg/hl	*Screenings %	*Delivery Grade	#Fert Input $/ha	^Returns $/ha
0	0	162	2.58	7.7	80	2.2	ASW	$ -	$ 792
	10	186	2.70	7.7	79.7	2.1	ASW	$ 12	$ 817
	25	203	2.77	7.7	79.7	2.2	ASW	$ 31	$ 819
	50	186	2.79	7.7	79.8	2.0	ASW	$ 62	$ 795
40	0	218	3.38	8.8	79.3	2.2	ASW	$ 57	$ 981
	10	214	3.63	8.9	78.5	2.7	ASW	$ 70	$ 1,045
	25	225	3.45	8.7	79.3	2.5	ASW	$ 88	$ 971
	50	225	3.64	9.0	78.9	2.7	ASW	$ 119	$ 998
80	0	211	3.67	10.1	78.5	3.0	APW2	$ 121	$ 1,031
	10	224	3.82	9.9	77.3	3.2	ASW	$ 134	$ 1,039
	25	231	3.99	9.8	78.1	2.8	ASW	$ 152	$ 1,073
	50	225	3.61	10.0	77.6	3.1	APW2	$ 183	$ 950
120	0	223	3.84	11.2	76.3	4.2	APW1	$ 185	$ 1,028
	10	253	3.92	11.2	74.6	5.0	APW1	$ 198	$ 1,041
	25	255	3.81	11.0	75.1	4.8	APW1	$ 216	$ 988
	50	232	3.93	11.1	75.6	4.7	APW1	$ 247	$ 995
CV		8.8	6.01	3.03	0.57	8.8			
LSD 5%		31.8	0.348	0.48	~	~~			

Notes: All prices net delivered/received Kwinana and GST Exclusive

* Delivery grade $/T Kwinana 19 December 2014: ASW $307 APW1 $316, APW2 $314.

\# March 2014 retail price (per kg ex Kwinana), N Urea $1.30, K MOP $1.24, June 2014 UAN $1.60

^ Gross margin calculated using yields and grade value above and subtracting the cost of fertilizer applied

~ Data presented as back transformed means (Square Root)

~~ Data presented as back transformed means (Arcsine)

While yield considerations are important, gross margin will indicate the potential grower return from fertilizer treatments. Cost of N and K nutrition at rates used in the trial ranges from $0 to $247 per hectare. Assuming all other costs being equal between treatments, crude gross margin achieved from 2014 yields can be calculated as above (Table 2).

Gross margin peaks at 80 kg N/ha plus 25 kg K/ha. Similar returns were indicatively achieved with 40 kg N/ha plus 10 kg K/ha. However, gross margin >$1000 per hectare and associated higher premium delivery grades were consistently seen at or above 80 kg N/ha.

Recommended N, and to some extent, K rates will be dependent on paddock history, soil type, fertilizer pricing , and also seasonal rainfall. In 2014 Yealering experienced close to long-term average of 300 mm rainfall for the growing season for all months except June – coinciding with the first UAN top-up application. The drier June may have limited the nitrogen moving into the root zone of the wheat, and it is possible that with an average June, the 80 and 120 kg N/ha treatments would have produced more heads, higher yields and greater grower returns than 40 N kg/ha.

CONCLUSION

- Both N and K have influenced wheat growth at the site, to varying degrees.
- Summit's complex soil test interpretation model recommended 90 kg N for a 3 T/ha wheat crop based on the soil sample analyses at this site. With a growing season rainfall of 300 mm and the responses in this trial, an N recommendation of 80 kg/ha appears appropriate.
- Potassium recommendations from the Summit model were 20 kg K for a 3 T/ha wheat crop. Potassium recommendations will be much more dependent on soil characteristics and laboratory test results, but even on the duplex soil at the site, 10 to 20 kg K/ha looks to be of benefit in helping plants to maximise the potential growth benefits from top-up nitrogen applications.
- Mace wheat utilises N nutrition for yield, on the whole, but protein does increase somewhat with increasing N application and targeting higher delivery grades is possible if desired.

ACKNOWLEDGEMENTS

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