Response of wheat to N and K rates with added Cu

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KEY MESSAGES

- Trial sowing at 11 June was later than optimal but plant growth was showing strong response to nitrogen (N) and some response to potassium (K) at 28 August.
- By harvest, Mace wheat showed significant grain yield response to nitrogen application but potassium response had moderated.
- No significant differences were seen from Cu application.
- Late sowing decreased yield potential from the start. Harvest yields ranged from 2 to 3 t/ha, with maximum yield and $/ha return at 80 kg N/ha and 12.5 kg K/ha.

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 levels will benefit from K application enabling it to make full use of applied N during the crop growth cycle. High yield potential crops in the area have shown decreased rigidity in foliage and tillers, with low Cu status suspected. Uptake of Cu can be influenced by rapid growth and N uptake. Application of Cu before rapid plant expansion was also to be tested.

Table 1. Soil Test results

Depth	NO_3 N	NH_4 N	P	K	S	Cu	Zn	OrgC	pH $CaCl_2$	Al	EC	PBI
0-10	6	2	15	47	7	0.26	0.51	1.40	6.1	0.6	0.06	11
10-20	1	1	7	24	3				5.6	0.3	0.02	
20-30	6	1	11	39	3				4.7	1.2	0.02	

METHODOLOGY

K treatments - 0, 12.5, 25 and 50 kg/ha applied as MOP at seeding - IBS
N treatments - 0, 40, 80 and 120 kg/ha applied as Urea 50 kg/ha at seeding – banded, plus UAN split at 5 and 8 weeks after seeding – streaming nozzles
Cu treatment - 300 g/ha applied as $CuSO_4$ at 11 weeks after seeding
Replicates: 3
Crop type and variety: Mace wheat
Seeding rate and date: 75 kg/ha on 11/6/2014
Seeding basal fertilizer: MAPSZC® 50 kg/ha (N 6, P 10, S 3 kg/ha)

RESULTS AND DISCUSSION

At 28 August, 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 K and nitrate concentrations in the leaves.

By harvest, the response to N was still evident, but the K response had moderated. There was no impact from Cu application, so all figures quoted are averages of +Cu and –Cu.

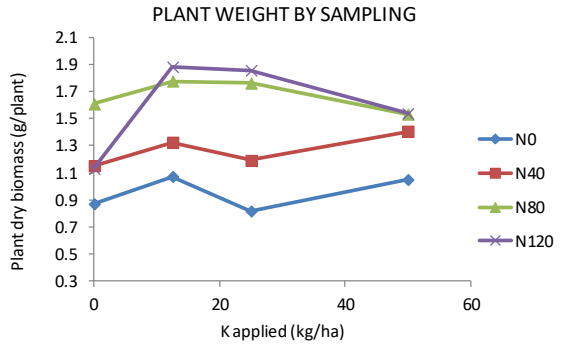

Figure 1. Effect of N and K application rates on mid-season crop growth, 28 August.

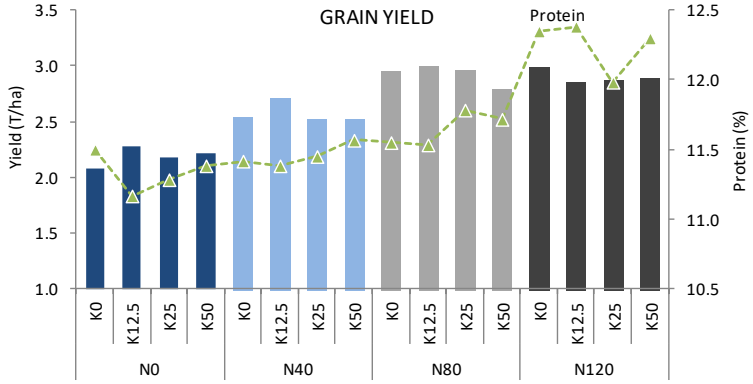

Figure 2. Effect of N and K application rates on crop grain yield and grain protein content

Grain yield responded significantly only to N, not K. Yields ranged from 2.08 t/ha, to 3.00 t/ha with more than 80 kg N/ha and 12.5 kg K/ha applied (Figure 2).

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 AGP1 to AUH1 (Table 2). If considered individually, a number of the plots would have met the APW1 and H2 grades but high screenings, especially with increasing N rate resulted in downgrade of plot averages.

While grade premiums are worth some consideration, yield remains the main driver of grower returns. It is still worth noting that Mace has some capacity for both yield and quality premiums if supplied good levels of nutrition.

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, gross margin achieved from 2014 yields can be calculated (Table 2).

Gross margin peaked at $801 from application of 80 kg N/ha plus 12.5 kg K/ha. Similar indicative returns were achieved with 80 kg N/ha plus 0 and 25 kg K/ha.

Table 2. **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	194	2.1	11.4	74	5.3	AGP1	$0	$605
	12.5	203	2.3	11.2	76	4.3	APW1	$16	$704
	25	209	2.2	11.3	76	4.6	APW1	$31	$659
	50	181	2.2	11.4	77	3.5	APW1	$62	$639
40	0	235	2.5	11.4	77	6.7	AGP1	$57	$683
	12.5	238	2.7	11.4	76	7.1	AGP1	$73	$717
	25	240	2.5	11.5	77	5.3	AUH2	$88	$703
	50	233	2.5	11.6	74	6.7	AUH2	$119	$671
80	0	272	2.9	11.6	76	5.9	AUH2	$121	$792
	12.5	260	3.0	11.5	75	6.6	AUH2	$137	$801
	25	248	3.0	11.8	75	7.8	AUH2	$152	$775
	50	263	2.8	11.7	75	7.9	AUH2	$183	$689
120	0	269	3.0	12.4	73	9.2	AUH2	$185	$749
	12.5	267	2.9	12.4	73	9.8	AUH2	$201	$692
	25	282	2.9	12.0	74	8.6	AUH2	$216	$682
	50	299	2.9	12.3	75	8.7	AUH2	$247	$657
CV		10	12.6	2.7	3	31.8			
LSD 5%		31.8	38	0.5	0.5	NS	3.5		

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

* Delivery grade $/T Kwinana 19 December 2014: AGP1 $291 APW1 $316, AUH2 $313.

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

NS No significant difference

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