Potassium in wheat: source, rate, timing and placement

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Purpose: To assess the value of muriate and sulphate sources of potassium on growth and yield of wheat when applied by banding and topdressing at seeding time or topdressing after emergence.

Location: WMG main trial site, Roberts Farm, Dandaragan

Soil Type: Brown loamy sand

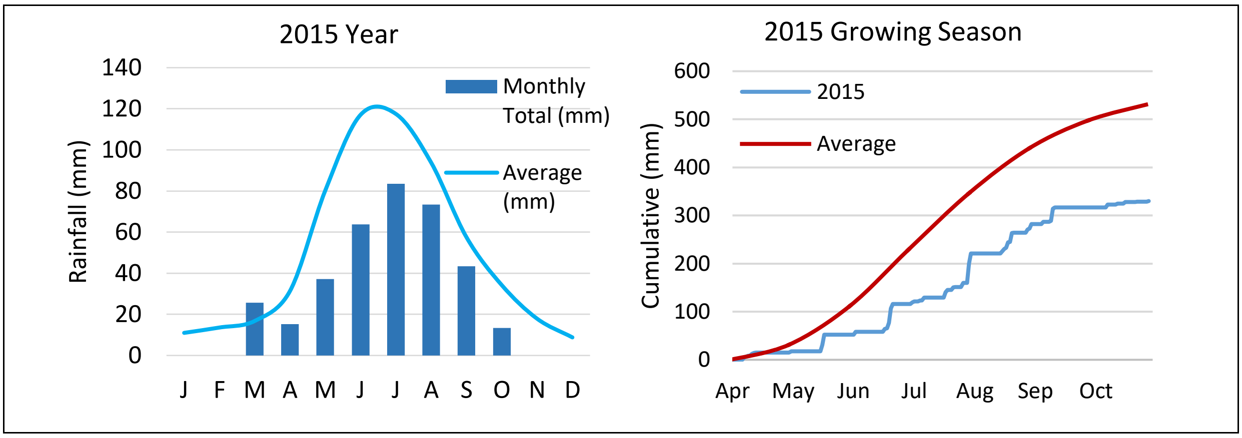
Soil Test Results:

Depth	NO_3^-	NH_4^+	OC	P	PBI	K	S	Cu	Zn	pH	Al
0-10cm	14	2	0.69	29	35	38	6	0.64	0.30	5.1	0.5
10-20cm	8	2	0.59	19	44	32	5	0.63	0.15	4.6	0.1
20-30cm	3	1	0.31	8	45	32	6	0.31	0.02	4.5	

Rotation: 2014 canola, 2013 wheat, 2012 oats

Growing Season Rainfall (April- October 2015): 330 mm [202 mm below average]

Figure 1: Pattern of monthly rainfall in 2015 and during the growing season. BOM Station 9014, Dandaragan West. 13 km west of trial site



BACKGROUND SUMMARY

Potassium (K) is required in large amounts by plants as an essential nutrient for growth and reproduction. A key component of moisture regulation, K improves the ability of crops to tolerate stresses and can enhance a crop's finish. This trial explored varying sources, rates, timings and placement of K to determine the optimal practice for K nutrition in the area.

TRIAL DESIGN

Plot size: 10 m x 1.8 m

Machinery: Small plot seeder with knife points and press wheels

Repetitions: 3

Crop type: Mace wheat

Seeding: 26/05/15 at 75 kg/ha

Herbicides/Fungicides: Uniform 3L/t coated on MAPSZC and GUSTO

Pre Em: SpraySeed 3L, Triflurex 2L, Chlorpyrifos 1L 11/05/15

IBS: BoxerGold 2.5L, Sprayseed 5L, Chlorpyrifos 1L 26/05/15
Post: 15/07/15 Velocity 1L, MCPA 750 0.5L, Hasten 1% 15/07/15

TRIAL LAYOUT

The trial consisted of 13 treatments replicated 3 times in a randomized complete block layout. Potassium was applied as different fertilizer compound sources; Gusto Gold; muriate of potash (MOP); and sulphate of potash (SOP), at a number of K rates ranging from Nil to 50 kg/ha, by either drilling in seed rows or by topdressing, either at seeding, immediately after seeding (PSPE), or four weeks after seeding (4WAS).

Table 2: Fertiliser application and treatments

Trt [ab]	K at seeding [c]	K PSPE	K 4WAS	Totals:	K	N	P	S
1					0	88	15	16
2	120 GustoGold				14	91	16	21
3	35 MOP				17	88	15	16
4	40 SOP				17	88	15	23
5		35 MOP topdress			17	88	15	16
6	35 MOP	35 MOP topdress			35	88	15	16
7	60 MOP				30	88	15	16
8	70 SOP				30	88	15	28
9		60 MOP topdress			30	88	15	16
10			60 MOP topdress		30	88	15	16
11	100 MOP				50	88	15	16
12		100 MOP topdress			50	88	15	16
13			100 MOP topdress		50	88	15	16

[a] All plots received MAXamFLO 70 L/ha in furrow at seeding, UreaPlus 80 kg/ha 4WAS and UAN 70 L/ha 7WAS
[b] All plots except Treatment 2 received MAPSZC 75 kg/ha banded at seeding
[c] Seeding treatments were banded immediately below the seed

GROWTH & YIELD RESULTS

Plant growth was monitored using measurement of normalized difference vegetation index (NDVI) by handheld Greenseeker®. Differences were small throughout the growing season, but there was a relationship trend of increased growth with increased K applied. When comparing other treatment aspects, there was little biomass difference seen between either different K fertilizers, different application methods or different application timing.

Notably, there was no observable decrease in emergence or growth in response to MOP applications at the highest rate of 100 kg/ha. High rates are sometimes raised as a concern among growers due to the chloride content of MOP being detrimental to germination and crop emergence. Although we wished to test this rate of MOP applied down the same tube as the seed, the drilled treatments were actually banded below the seed and this may have given enough separation to mitigate any potential chloride toxicity effects.

Harvested grain yield is shown below (Figure 2). Treatments showed general trends of differences, reflecting the small but observable plant growth differences. However, differences were not significant at a 95% level of confidence. This is most likely due to abnormal variation in a small number of plots, since statistical tests were approaching significance ($p=0.0501$).

The yield from the low rate of SOP was unusually high compared with other treatments of similar K rate. The reason for this is not easily explained. It is unlikely that Sulphur is responsible, since neither the higher rate of SOP or Gusto Gold (compound containing K from a sulphate source) showed marked differences in yield from similar application rate treatments. More investigation of the role of rate and K source in combination is required to confidently say if this is a real and reproducible effect.

Figure 2: Wheat yield in response to different K fertilizer treatments. Bars are standard errors and numbers show the total K rate applied (kg/ha)

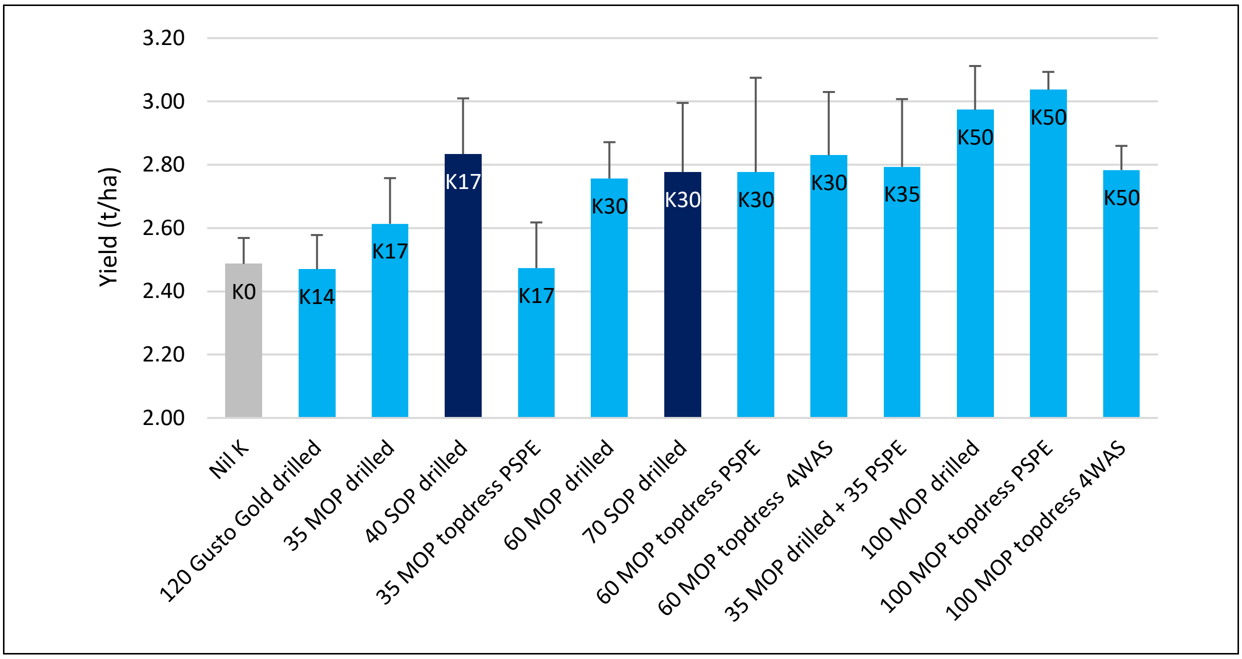
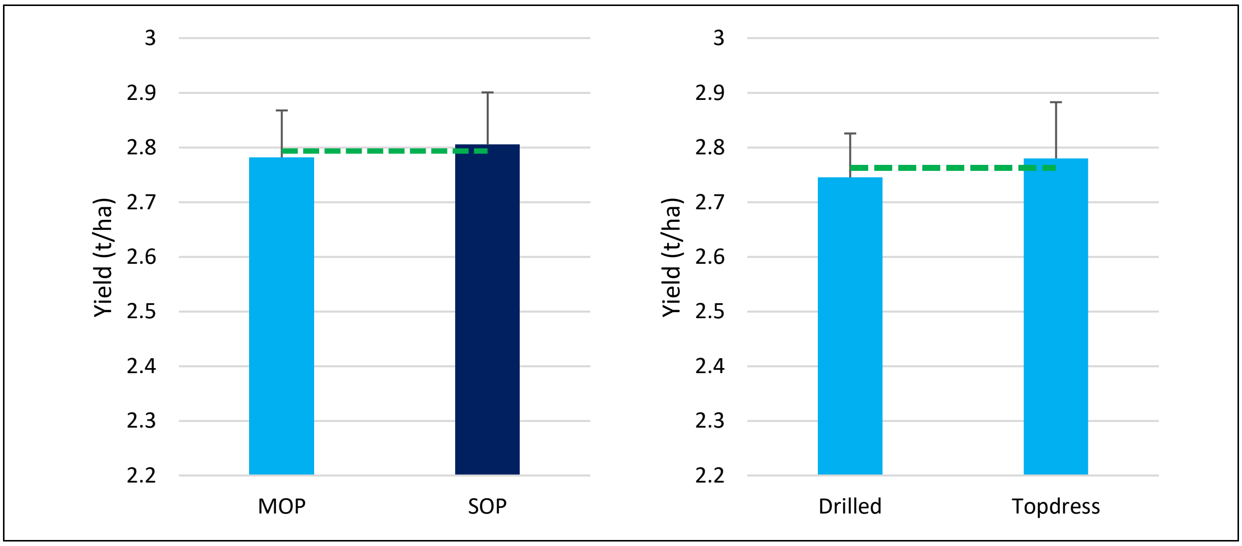


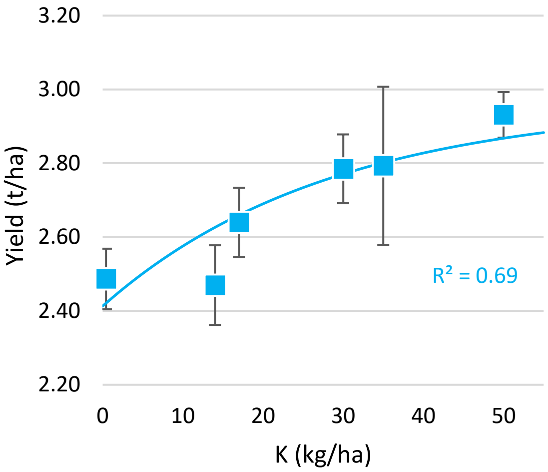
Figure 3: Pooled data comparisons of K source and application method on grain yield (Bars are variance)



Yields were compared for treatments where similar total K rates were applied. Results were variable with some differences were seen at 17 and 50 kg K/ha, but little difference at 30 kg K/ha. So, when data was pooled, there was no discernible difference between either muriate or sulphate sources of K, or between drilled K at seeding or topdressing after seeding (Figure 3).

Pooling yields by rate of K applied shows that there were significant grain production responses to K rate. A Mitscherlich function fitted to this yield data gives a reasonable fit (Figure 4) and demonstrates that even in a below-average year, yield responses to K can be achieved. Potassium application at the rate of 30 kg/ha shows a definite increase in yield over 0-14 kg/ha, and higher rates achieved progressively less yield improvement.

Figure 4: Yield response curve to K rate. Bars are standard error (Mitscherlich function fitted)



SummitQ SNAPSHOT soil test response modelling is used to recommend rates of fertilizer to optimize yield and return over a target range after soil test results are analysed. Using K test results (Table 1) at the trial site, SNAPSHOT recommended K application of 24, 28 and 31 kg/ha for target yield of 2, 3 and 4 t/ha, respectively. These recommendation rates correspond reasonably with the K response curve (Figure 4), with the lower actual harvest yields being a result of the growing season rainfall (Figure 1). The SummitQ SNAPSHOT model has proved quite robust in this case.

Grain quality analysis found protein to be consistent and high (11.7-13.5%) across treatments due to the nitrogen applied and lower than average rainfall (Table 3).

Hectolitre weights, although showing an increase with increasing K application, were reasonably low (67-71.2 kg/hl) resulting in mostly General Purpose and Feed delivery grades. Only the MOP drilled 100 kg/ha treatment exceeded AUH2 grade standards. This significantly impacted grain value and indicative returns.
Screenings showed a general decrease with increasing K applied, ranging from >8% with Nil K, to <5% where MOP was drilled below the seed at 60 and 100 kg/ha.

The potential for improvement in quality aspects from K application is an important consideration in maximizing crop returns.

Table 3: Fertilizer cost, wheat yield, grain quality and gross margin net of total fertilizer input costs

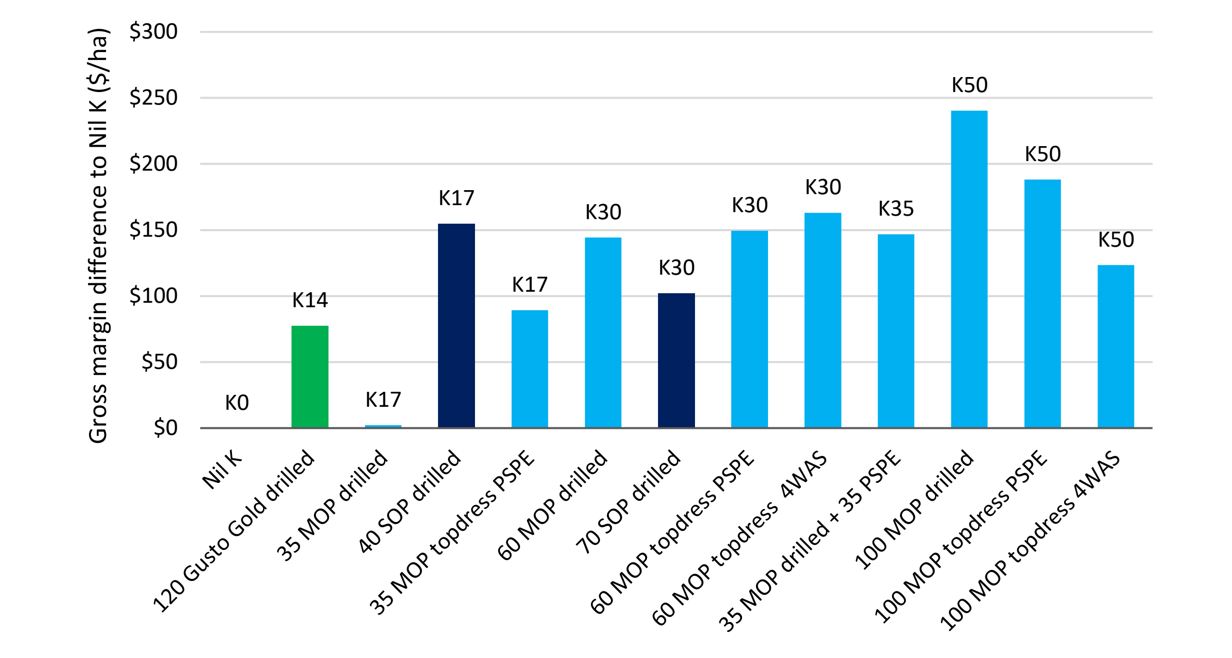
Treatment	K	Fert cost $/ha	Yield t/ha	Protein %	Weight kg/hl	Screenings %	Grade	Grain $/ha	Returns $/ha
Nil K	0	$193	2.5	12.5	67.0	8.3	FED1	$517	$325
120 Gusto Gold drilled	14	$228	2.5	12.6	68.2	7.7	AGP1	$630	$402
35 MOP drilled	17	$217	2.6	13.5	67.2	7.2	FED1	$544	$327
40 SOP drilled	17	$243	2.8	11.7	69.0	6.5	AGP1	$723	$479
35 MOP topdress PSPE	17	$217	2.5	11.9	69.0	5.6	AGP1	$631	$414
60 MOP drilled	30	$234	2.8	12.0	68.8	4.9	AGP1	$703	$469
70 SOP drilled	30	$281	2.8	11.8	69.4	6.4	AGP1	$708	$427
60 MOP topdress PSPE	30	$234	2.8	11.8	69.2	5.6	AGP1	$708	$474
60 MOP topdress 4WAS	30	$234	2.8	11.8	69.4	5.3	AGP1	$722	$488
35 MOP drilled + 35 PSPE	35	$241	2.8	12.4	69.2	5.5	AGP1	$712	$471
100 MOP drilled	50	$262	3.0	11.9	71.2	4.5	AUH2	$827	$565
100 MOP topdress PSPE	50	$262	3.0	11.7	70.2	6.1	AGP1	$774	$513
100 MOP topdress 4WAS	50	$262	2.8	12.1	70.6	5.4	AGP1	$710	$448

FINANCIAL ANALYSIS OF RESULTS

While yield is important, gross margin calculations indicate the potential grower returns from fertilizer application.

Compared with the Nil K treatment, all treatments showed an increase in net return by application of K (Figure 5). Returns generally increased as rate of K application increased, and returns from drilled MOP at 100kg/ha were significantly higher than all other treatments. Certainly, rates of K 17 kg/ha or lower were not sufficient to maximize yield and returns on this site. Based on fertilizer input costs alone, there was no advantage in splitting K applications or in topdressing either before or after crop emergence, compared with drilled application at seeding.

Figure 5: Relative increases in margin return, net of all fertilizer costs, from application of K



KEY CONCLUSIONS

- Mace wheat responded positively to K.
- Source of K (SOP or MOP product) and timing had minimal impact on growth or yield response.
- Drilled MOP at 100 kg/ha produced the greatest yield and returns but evidence that drilled K is better overall than topdressed applications was not conclusive.
- SummitQ soil test modelling gave an accurate prediction of optimal K fertilizer rate.
- Grain quality was characterized by low hectolitre weights, but increasing K application improved both hectolitre and screenings quality aspects.

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