Matching P and N rates to yield potential on sands

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Purpose: These trials were conducted to examine the likelihood of economic returns to VRT on sandplain soils

Location: Badgingarra Research Station

Soil Type: Site 1: Strong gravelly sand

Site 2: Deep white sand

Soil Test Results:

Site 1	P mg/kg	K mg/kg	S mg/kg	OC %	Cu mg/kg	Zn mg/kg	PRI	EC mS/m	pH CaCl2	Al mg/kg	Gravel %
Topsoil (0-10cm)	15	50	9	1.86	0.33	2.03	5	0.1	5.1	2.0	10-15
Subsoil (20-30cm)	5	43	8	0.33	0.13	0.15	12	0	6.3	0.0	75-80
Site 2	P mg/kg	K mg/kg	S mg/kg	OC %	Cu mg/kg	Zn mg/kg	PRI	EC mS/m	pH CaCl2	Al mg/kg	Gravel %
Topsoil (0-10cm)	9	68	6	1.15	0.32	1.39	2	0	5.4	1.1	0
Subsoil (20-30cm)	7	22	1	0.23	0.18	0.07	2	0	4.8	1.5	0

Rotation: 2009 Wheat; 2008 Lupins; 2007 Oats; 2006 Lupins

GSR: 300mm

BACKGROUND

Two identical trials were sown on around 100m apart, the first on a strong gravelly sand with a high yield potential, and the second on a deep white sand, with lower clay content and lower yield potential. The purpose was to investigate the economics of variable rate fertiliser applications by comparing the response to additional N and P on variable sandplain.

In 2009 the plots were sown to wheat, however due to herbicide damage the trial was not harvested. In 2010, the second year of the trial, canola was sown over the 2009 plots to investigate the effect of continuing high or low rates of N and P (similar to a VRT situation).

TRIAL DESIGN

Plot size: 20m x 2.2m

Sowing Date: 7 May 2010

Machinery: Kalyx plot seeder, knife points and presswheels

Crop details: Canola

Basal Fertiliser: 100 kg/ha MOP (Topdressed IBS)

Herbicide: **Pre-seeding:** 2 L/ha Trifluralin; 1 L/ha Chlopyrifos; 2 L/ha PowerMax; 200 mL/ha Alphacypermethrin; 200 mL/ha Talstar

Post (7/7/10)**:** 1.1 kg/ha Atrazine; 500 mL/ha Select; 300 mL/ha Lontrel; 2% v/v DC Trate

No.	Treatment	Rate		Timing	Total N	Total P
1	Untreated control				0 kg/ha	0 kg/ha
2	Urea Plus	107	kg/ha	topdressed IBS	120 kg/ha	0 kg/ha
2	Urea Plus	107	kg/ha	topdressed 3 WA-S		
2	Urea Plus	107	kg/ha	topdressed 8 WA-S		
3	MPZ	143	kg/ha	banded at sowing	15 kg/ha	30 kg/ha
4	Urea Plus	107	kg/ha	topdressed IBS	135 kg/ha	30 kg/ha
4	MPZ	143	kg/ha	banded at sowing		
4	Urea Plus	107	kg/ha	topdressed 3 WA-S		
4	Urea Plus	107	kg/ha	topdressed 8 WA-S		
5	Urea Plus	107	kg/ha	topdressed IBS	95 kg/ha	30 kg/ha
5	MPZ	143	kg/ha	banded at sowing		
5	Urea Plus	107	kg/ha	topdressed 3 WA-S		
6	Urea Plus	107	kg/ha	topdressed IBS	45 kg/ha	30 kg/ha
6	MPZ	143	kg/ha	banded at sowing		
7	Urea Plus	107	kg/ha	topdressed IBS	128 kg/ha	15 kg/ha
7	MPZ	71.5	kg/ha	banded at sowing		
7	Urea Plus	107	kg/ha	topdressed 3 WA-S		
7	Urea Plus	107	kg/ha	topdressed 8 WA-S		
8	Urea Plus	107	kg/ha	topdressed IBS	124 kg/ha	7.5 kg/ha
8	MPZ	35.75	kg/ha	banded at sowing		
8	Urea Plus	107	kg/ha	topdressed 3 WA-S		
8	Urea Plus	107	kg/ha	topdressed 8 WA-S		

RESULTS

Crops were assessed for early crop vigour at 61 DAS, with visual ratings ranging from 53-77% across both sites. Phosphorus application significantly increased vigour on both sites, while Nitrogen only significantly increased vigour on the gravel site (table 1). The highest crop vigour was achieved on both sites for the 90 N, 30 P treatment, but this was not significantly different to several other treatments.

Table 1. *Results and ANOVA for Visual crop vigour ratings (0-100) at 61 DAS.*

No.	Treatment	Crop Vigour (0-100), Sand		Crop Vigour (0-100), Gravel	
1	UTC	53.3	d	53.3	d
2	0 P, 120 N	58.3	d	63.3	c
3	30 P, 15 N	65.0	c	65.0	bc
4	30 P, 120 N	76.7	a	71.7	ab
5	30 P, 90 N	76.7	a	73.3	a
6	30 P, 60 N	70.0	bc	70.0	abc
7	15 P, 120 N	71.7	ab	71.7	ab
8	7.5 P, 120 N	68.3	bc	71.7	ab
LSD (P=.05)		5.4		7.8	
CV		4.5		6.6	
Treatment Prob(F)		0.000		0.001	

Means followed by same letter do not significantly differ (P=.05, LSD)

One of the key benefits to early vigour in canola is that it can be highly correlated to grain yield in many cases. This correlation was the strongest on the gravelly site, where there was a 74% correlation between early vigour and grain yield, while on the sand, which suffered from a very poor finish, there was still a 60% correlation. This result highlights the importance of setting up a healthy vigorous plant at the start of the season with a good P rate and sufficient starter nitrogen.

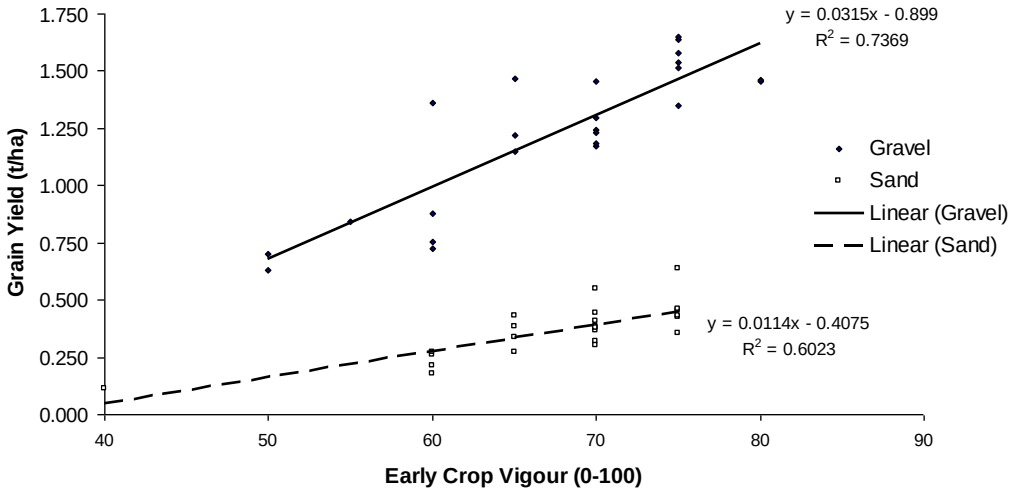

Figure 1. *Correlation between early crop vigour (0-100) and grain yield (t/ha)*

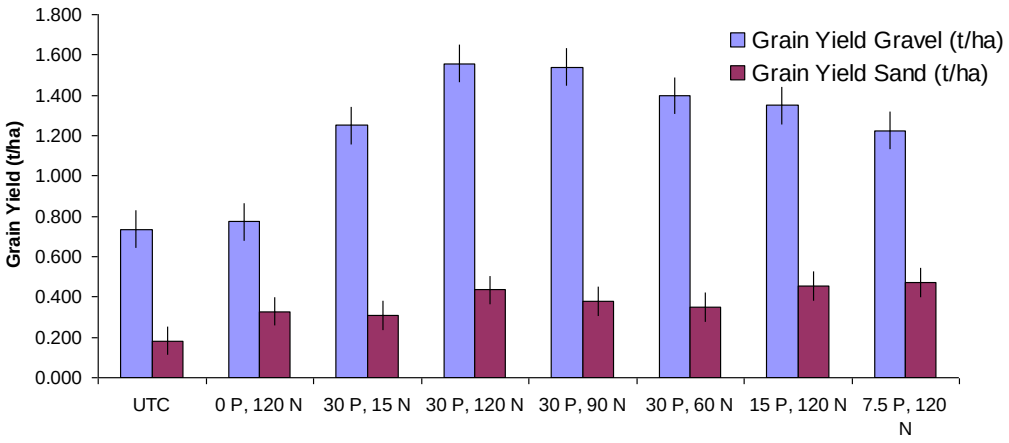

Figure 2. *Grain yield (t/ha) for both the Gravel and Sand sites. Error bars represent LSD (p=0.05)*

Yields on the gravel ranged from 0.7-1.6 t/ha, with the untreated control showing yielding the least (figure 2). Nitrogen at 120 kg/ha with nil P was the only treatment not to show significantly higher yield than the control, suggesting that this soil type was strongly P responsive. Statistically, the highest yields were achieved at 30 kg/ha P with 60, 90 or 120 kg/ha N.

The sandy site yielded far less than the gravel, ranging from 0.2-0.5 t/ha and while there were some significant differences, all treatments performed poorly. This suggests that the

major limiting factor on this soil type is not nutritional, and that something else determines maximum grain yield, in this case soil moisture holding capacity.

To investigate the hypothesis that non wetting and poor establishment on these soil types is a major determinant of yield each plot was visually rated for emergence to determine correlation to grain yield. Figure three shows that, despite having emergence ratings ranging from 20-70% across the site, there was no correlation between emergence and yield. The conclusion from this is that more plants did not result in more yield at this site, and even if non wetting was overcome canola yields would still be low on these sands.

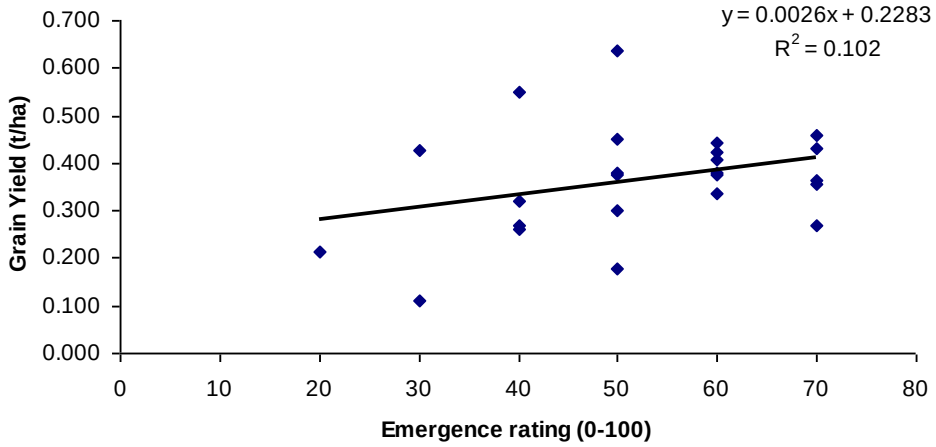

Figure 3. *Graph showing Grain yield (t/ha) against Emergence (0-100) at the sandy site at Badgingarra**.***

DISCUSSION

- In a below average rainfall year, with a very dry finish gravelly sands were still highly responsive to applied P, with 0.6 t/ha response to 60 kg/ha P over the last two years and 30 kg/ha applied this year
- Nitrogen in the absence of phosphorus did not significantly increase yield at either site. This highlights the requirement to get your P rates tailored to your potential at seeding time, as low P rates may limit N response in a good year.
- There was strong correlation between early vigour and grain yield at both sites, again highlighting the need to establish a strong, healthy crop with sufficient early nutrition.
- Increasing plant numbers did not result in increased grain yield on poor sands.
- This trial shows that on variable light country variable rate fertiliser applications would be a useful tool to improve nutrient use efficiency on variable sands, as both sites had significantly different yield potential and nutrient requirement.

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