SOIL AND PLANT TESTING FOR BETTER FERTILISER DECISIONS

2020 CASE STUDY AND GROWER FEEDBACK: ECONOMIC GAINS THROUGH SOIL TESTING IN THE MID NORTH

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The following case study is an explanation of the procedure involved with GRDC project: Using soil and plant testing data to better inform nutrient management and optimise fertiliser investments for grain growers in the southern region.

Wheat response to P fertiliser in deficient soils: a 2020 case study

Location: Nantawarra, SA

Crop: Wheat (Scepter)

Standard fertiliser practice at seeding: 23N-18P-0-1 @ 100kg/ha

What was done?

Satellite-based NDVI imagery from previous growing seasons, which indicates biomass density and condition, was used to identify two production zones (1 ha area) within the paddock: a high production zone (Zone 1) and a low production zone (Zone 2) (Figure 1). Soil tests prior to seeding indicated phosphorus (P) deficiency was highlighted in Zone 2 (Table 1). Phosphorus fertiliser test strips were implemented across both production zones at three rates: Nil, grower standard rate and double rate (0P, 18P, 36P). Profile N values were moderate and enough to support early crop growth. The crop was top-dressed with a 50:50 split of urea (42N) and sulfate of ammonia (21N) at 60 kg/ha, providing 25 kg and 12 kg N/ha respectively in early August.

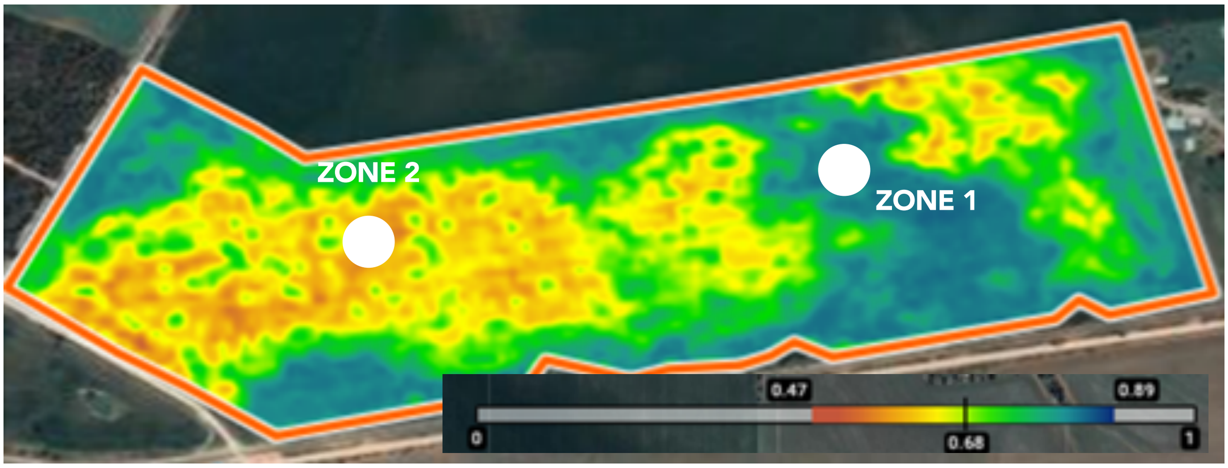

Figure 1. Paddock NDVI imagery with two production zones highlighted.

Table 1. Soil test results from the two different production zones. Zone 1 – target Colwell P = 26, Zone 2 – target Colwell P = 34. Critical value for DGT (wheat = 60).

Zone	Profile mineral N (kg/ha)	Colwell P (mg/kg)	PBI	DGT-P (μg/L)
Zone 1	149	47	85	58
Zone 2	190	30	162	30

Crop tissue tests taken at GS30 (stem elongation) within each treatment and zone, showed that tissue concentrations of P generally increased with fertiliser rate (Figure 3). There is a trend of higher biomass production as fertiliser rate increases (Figure 2) which is clearly visible in the paddock (Figure 5; Figure 6).

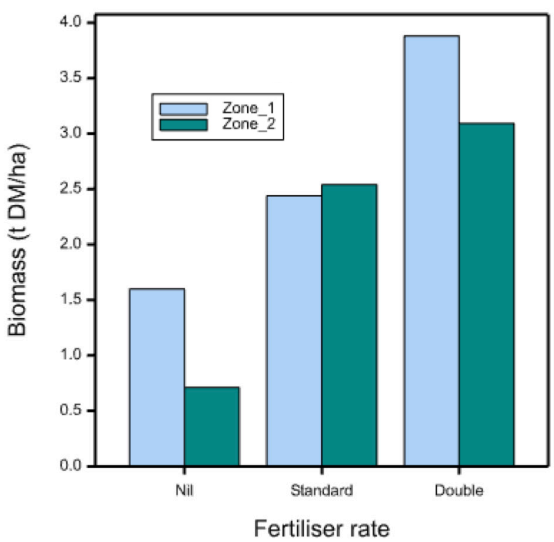

Figure 2. Crop biomass (g DM) within each fertiliser strip in both zones.

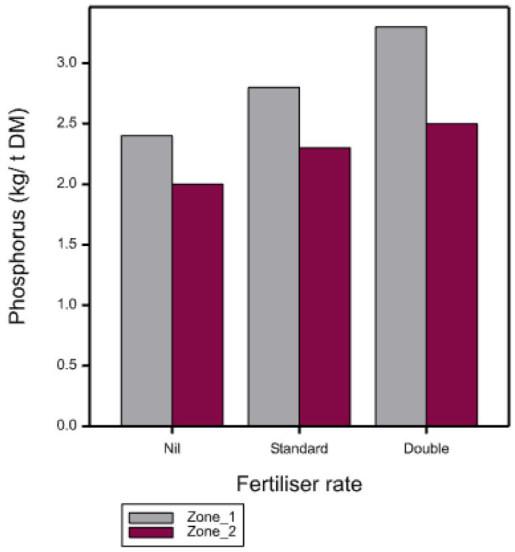

Figure 3. Plant tissue Phosphorus quantities.

What's to come?

Yield data and an economic analysis will determine whether there are significant yield responses between fertiliser rates within each zone, and the profitability of altered fertiliser practices in this paddock.

The aim to the GRDC project is to demonstrate the value of soil and plant testing by placing this value in terms of economic gains with increased yields or improved fertiliser application efficiency. Grower and advisor attitudes to soil and plant testing are a key component and we took time out to interview a participant in the project to quiz them on some key aspects of the project.

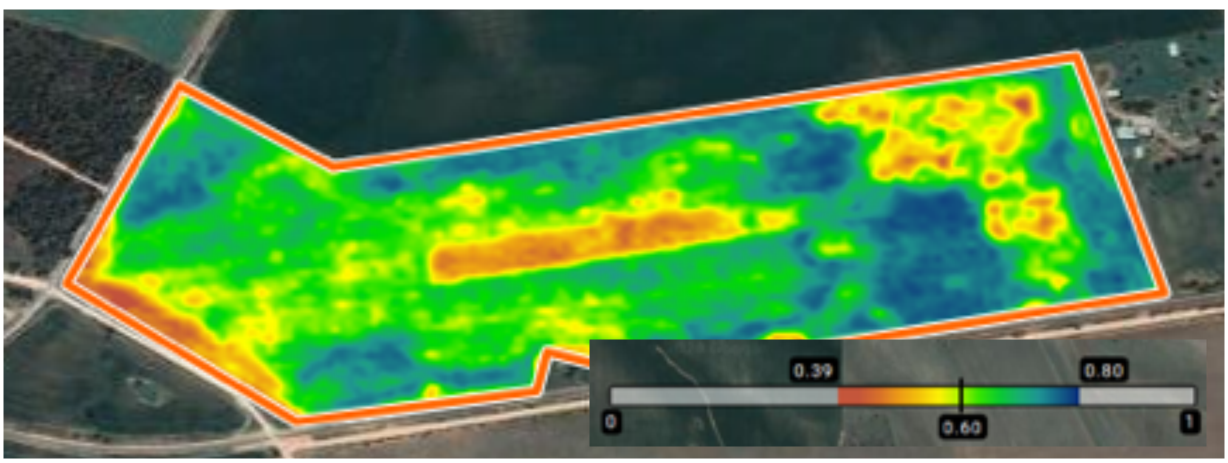

Figure 4. NDVI image (23rd July 2020) outlining the fertiliser treatment effects across the paddock (Courtesy of Data Farming)

Figure 5. Aerial imagery of the paddock. Treatment order (left to right): Grower standard rate, nil, double fertiliser.

Figure 6. Nil fertiliser strip biomass (left) and double fertiliser strip biomass (right).

Comments from the agronomist…

Q: Prior to participating in the project were you aware that the paddock was P deficient?

A: Not really, we have historically applied P to match crop removal only.

Q: Have you/the grower faced challenges implementing/managing the fertiliser test strips?

A: No, the larger nature of the trial strips made the process relatively easy.

Q: In the past were you aware of the degree of variability across the paddock? Would you recommend using variable rate fertiliser in this paddock in the future if you aren't already?

A: Yes, soil type variation is common and often obvious to see when looking at crops throughout the year. Variable rate might be an option in the future, although the seeder does not have this feature. Applying manures or additional fertiliser (via spreader) to these areas would be more feasible in the short term.

Q: Going forward, would you consider continuing to use fertiliser test strips in your paddocks? Why/why not?

A: Yes, simple nil and double fertiliser strips, and possibly N rich strips, are an easy way to check nutrition responses.

Q: Do you have any advice for somebody who suspects they have a soil nutritional deficiency?

A: Basic soil testing as a starting point, then fertiliser test strips to ground truth, and possibly soil test mapping to fine tune things after that. Also, we need good yield maps to check if these deficiencies are limiting yields.

IMPORTANCE OF IDENTIFYING PADDOCK ZONES IN TERMS OF MAXIMISING GROSS MARGINS WITH SOIL TESTING AND DATA LAYERS.

What was done?

Trengove Consulting has identified different production zones (NDVI, grain yields) across paddocks can be linked to soil properties which drive Phosphorus availability. These soil properties can be pH, soil carbonate levels and the P fixation potential (measured by PBI) which can change dramatically over very short distances within a paddock. Through a SAGIT funded project Trengove Consulting tested the implications of these soil attributes on economic P rates by running 4 replicated field P response trials in different zones at two sites in the Mid-North. We have used this response data to outline the potential economic gains that can be made by moving to zone specific soil sampling.

Results

Phosphorus deficient zones were identified at both sites and coincided with high pH, presence of carbonate and corresponding higher PBI zones. Based on yields obtained in 2019 at both sites two zones at the Kybunga site and two zones at Bute responded to P applications well above replacement P rates. These zones were identified by pre sowing soil tests (DGT P and PBI) as requiring higher than replacement P rates to optimise yields. The importance of low P zone identification through soil testing was evaluated by using the gross margins obtained at predicted required P rates and the gross margins obtained at replacement P rates calculated as 3 kg P/ha for every t/ha of grain (Table 2). In scenarios where soil test results were above critical values the recommended P rate resorted back to replacement P rates and therefore both scenarios produce the same partial gross margin. Informed P rates through soil testing was highly profitable for highly P responsive zones (Kybunga – 1,2, Bute – 3). With this analysis it is important to factor in the amount of area and soil type the soil test value relates to for the overall cost benefit of using soil testing for P in the Mid-North region.

What's to come?

Data generated from the GRDC project is undergoing economic analysis to provide information on the value of soil and plant testing for P and N across the Southern region. This assessment will be combined with 2020 season results.

The SAGIT project run by Trengove consulting is continuing for the 2020 season and the combination of two seasons results will be communicated through Hart.

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Table 2: Influence of soil test information on recommended P rates and the partial GM generated compared to replacement P strategies. *Replacement P rates based off 2019 yield potentials at each zone and calculated as 3 kg P/ha for every t/ha grain.

2019 Trial locations	Production zones	P replacement rates kg/ha*	DGT P ug/L	PBI	Recommended DGT P rate kg/ha	1) Grain yield at replacement P rate t/ha	2) Grain yield at soil test P rate t/ha	Partial GM 1 $/ha	Partial GM 2 $/ha	Advantage of soil test over Replacement P
Koolunga	Zone 1	7	20	126	31	1.95	2.36	979	1136	157
	Zone 2	9	25	141	29	2.54	2.92	996	1130	133
	Zone 3	10	93	44	> Critical	3.1	3.1	1002	1002	0
	Zone 4	9	71	73	> Critical	2.65	2.65	992	992	0
Bute	Zone 1	16	150	25	> Critical	5.09	5.09	1055	1055	0
	Zone 2	14	51	61	4	4.6	4.6	1043	1043	0
	Zone 3	15	20	90	24	4.16	4.42	1046	1108	62
	Zone 4	16	35	73	12	5.12	5.01	1057	1024	-33
							Total ($/ha)	8170	8490	