Targeted Barley Boost - Variable Rate Focused Fertiliser Strategies

Lowbank Case Study

BACKGROUND

This project aimed to build on work produced in 2022 across three farmer groups in the SA mallee region where variability in crop responses to Nitrogen (N) and Phosphorus (P) applications across paddocks were demonstrated through multiple replicated small plot trials.

Growers were asked to select a paddock of interest and create different soil and therefore management zones through publicly available satellite and NDVI data. Growers were then encouraged to implement fertiliser strip trials by adjusting fertiliser rates (50% down, 50% up compared to grower practice) across these zones. Assessments of crop behaviour to different fertiliser programs across zones will assist growers to start the journey of implementing VRT.

The following reports on results obtained from a focus paddock in the Lowbank district.

SNAPSHOT

Size: 9000 ha, Cropped 6500 ha
Location: Lowbank, SA
Enterprises: Cropping & Sheep
Rotation: 3 year rotation 2 - 3 x cereals (depending on paddock performance & grasses) then medic or vetch pasture
Rainfall: 250 mm - (175 mm in growing season)
Soil types: Sands, Loams, Flats, Constrained Flats, Reef Flats
Demonstration type: VRT strips vs P rich strips (as MAP) - Barley
Fertiliser rates: 25-65 kg MAP/ha (Grower Rate) vs 80 kg MAP/ha

METHODS

The selected paddock was viewed in Google Earth and Data Farming to outline potential soil types driving crop production. Both platforms are free with the ability to go back through previous seasons to assess NDVI patterns with crop rotations. NDVI patterns during early growth stages were the focus as this has been shown to be particularly useful for identifying P responsive areas on YP and Mid-North regions.

In this example we had access to an EM38 map which can be an important additional layer to look at soil profiles and potential behaviour regarding constraints and water storing capabilities. From these zones soil samples were collected (0-10, 10-30, 30-50cm) and fully characterised where expected responses to N and P inputs were predicted (table 1).

Peter Treloar had already set up a VRT MAP rate map for this paddock based largely off EM38 readings where higher EM38 areas received lower starter MAP rates and lower EM38 soil types received higher MAP input. To confirm this approach two MAP rich strips (two seeder widths) were implemented at a rate of 80 kg MAP/ha (18 kg P/ha).

Urea was spread soon after crop emergence to negate the imbalance of applied N with increasing MAP rates. During the season plant tissue analysis was performed in and out of MAP rich strips along the VRT variable inputs.

Harvest barley yields were obtained for the MAP rich fertiliser strip treatment with two harvest runs analysed within each treatment to increase robustness. This was compared to two adjacent runs to the MAP rich strip with the northern most strip results reported below.

RESULTS

Two main soil types were described by Google Earth and NDVI images with the grey soil zones which are identified as Calcareous resulting in low relative NDVI values, and a darker loam associated with moderate to high in season NDVI values (photo 1). There was limited sandy soil types in this paddock to assess residual nutrient levels. Main soil descriptors indicated low to marginal P levels via Colwell P across all zones but P deficiency in zones 1-5 (grey Calcareous) as measured by DGT. DGT P levels were highly related to soil Phosphorus Buffering Index (PBI) which is a measure of the soil's ability to complex and fix P forms.Profile N values were low in zone 1,3 and 4 but ultimately underestimated in zones 1 and 4 with stones restricting coring to 30cm.

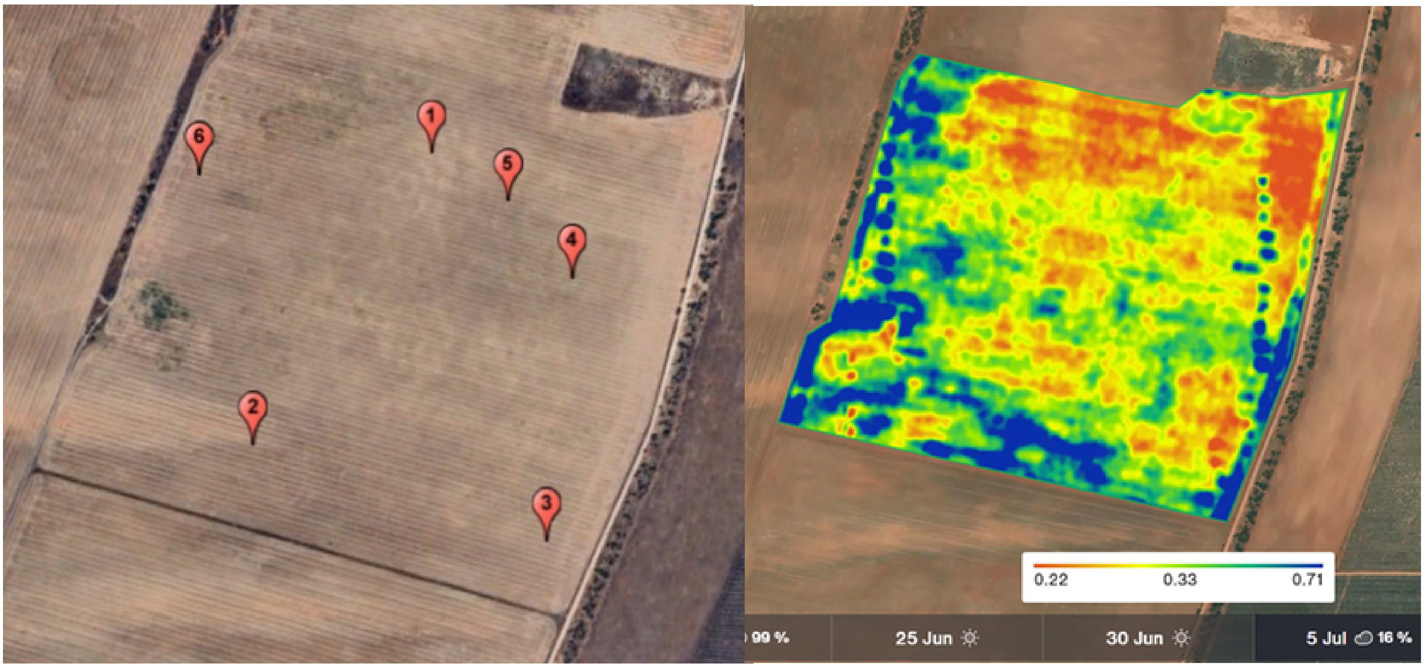
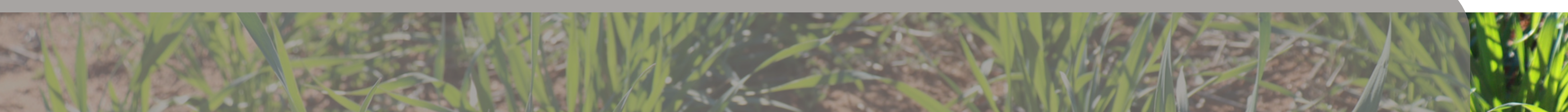


Photo 1: Google Earth image of focus paddock with associated sampling locations (table 1) - left and in season 2023 NDVI image using Data Farming (right). Samples 5 and 6 were taken pre sowing 2024 in response to 2023 grain yield results (sample 5) and high 2023 NDVI values (sample 6).

Table 1: Zone main soil characteristics. Profile N was calculated via mineral N values with depth. Target Colwell P values can be expressed either via PBI using relationship developed in Moody 2007* or Speirs et al. 2013 with critical values of 34 mg/kg for calcareous soils or 25 mg/kg for all other soils. Critical DGT P values have been established as 67 ug/L (58-77 Critical Range) regardless of soil type.

Zone (sample)	Description	OC (%)	Profile N (kg/ha)	Colwell P (mg/kg)	PBI	Target Colwell P* (mg/kg)	DGT P (ug/L)
1	Grey/Low NDVI	0.64	10	19	88	27	10
2	Dark/High NDVI	0.6	65	21	48	21	33
3	Grey/Low NDVI	0.57	28	20	44	20	34
4	Dark/Intermediate NDVI	0.81	17	26	78	25	23
5	Grey/Low NDVI (new 24)			23	79	25	24
6	Dark/High NDVI (new 24)			23	58	21	65



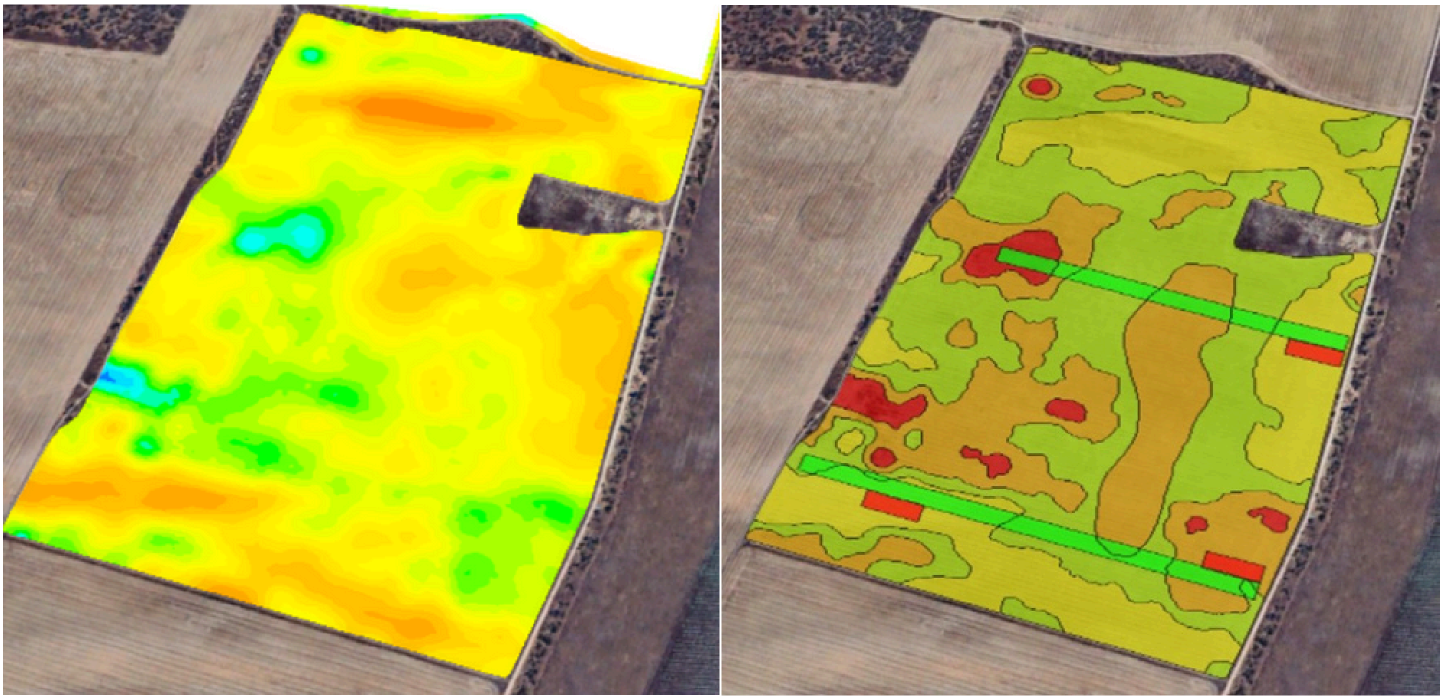


Photo 2: EM38 map of the selected paddock (left) with cooler colours representing greater conductivity and the VRY MAP input map (right) with location of two MAP rich strips. Red = 25, Orange = 40, lime = 60 and light green = 65 kg MAP/ha.

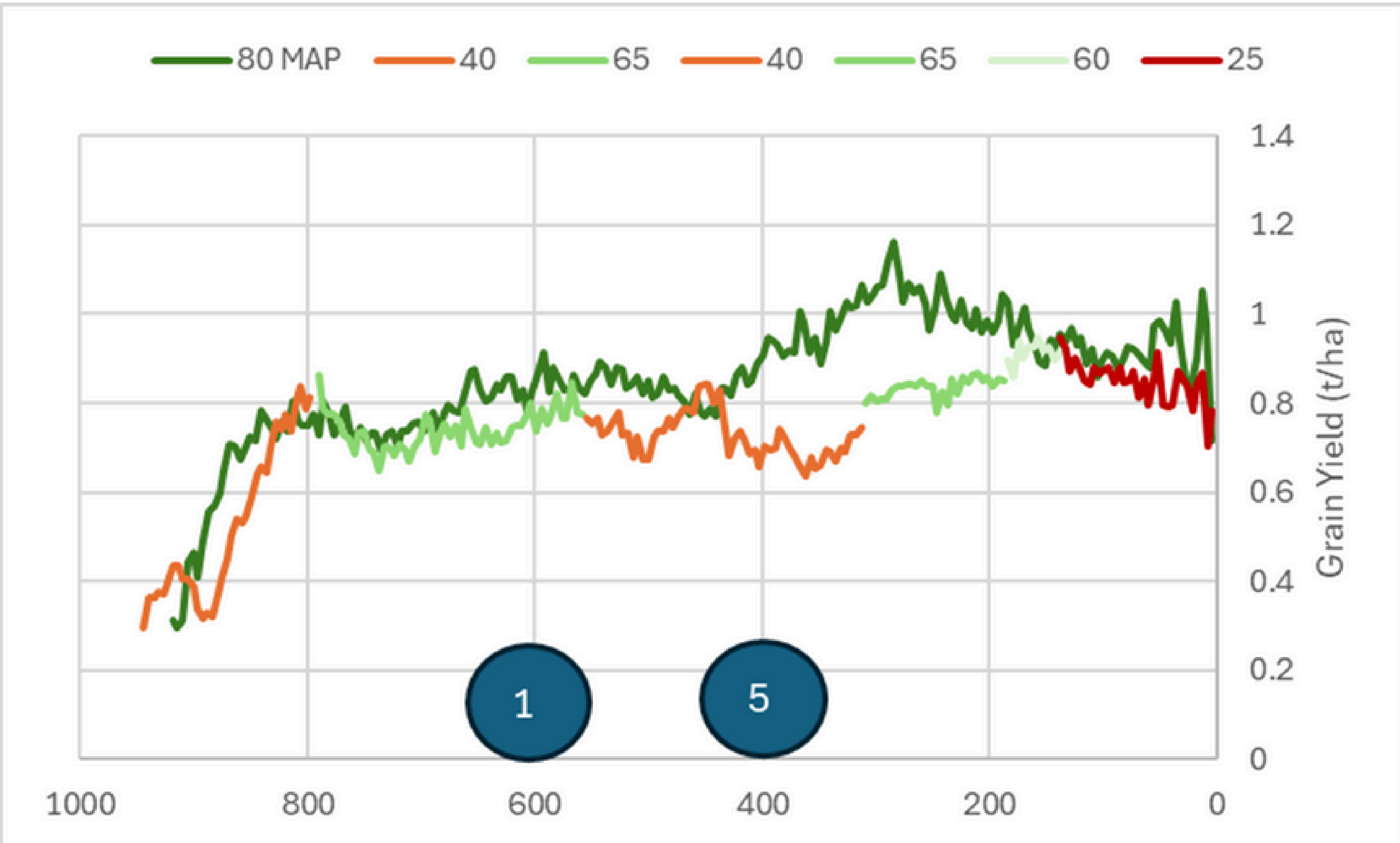


Figure 1: Barley grain yields (t/ha) recorded every 4-5m from West (left) to East (right) for the MAP rich strip at 80 kg/ha and the VRT plan immediately adjacent to the strip. Soil sampling locations relating to table 1 are marked 1 and 5 along the trial strip.

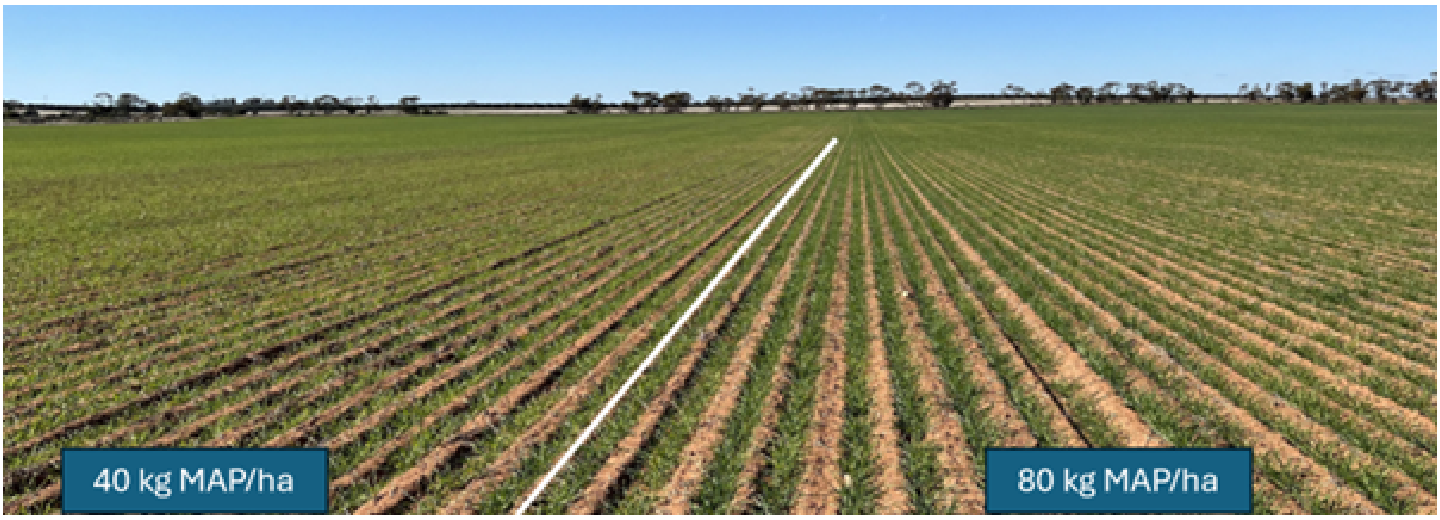
Barley grain yields for the average of two runs ranged between 0.6 and 1.2 t/ha excluding the low yields to the far west of the trial runs. Mean grain yields for each VRT MAP rate compared to the adjacent MAP rich strip are presented in table 2 with associated Partial Gross Margins (PGM) using 2023 pricing for grain and fertiliser prices. Average grain yield for the VRT treatment was 0.75 t/ha which was out yielded by the MAP rich treatment by 0.1t/ha to record 0.85 t/ha. The relatively high current price of fertiliser meant that this increase in grain yield effectively offset the increase in fertiliser cost which is an important result with grain yields around 0.8t/ha created by a late sowing date and a difficult end to the growing season.

Breaking down each zone there were two distinct zones where there was a penalty in dropping MAP rates below 80 kg/ha, the second zones of 40 and 65 kg/ha VRT rates. Grain yields increased by 0.17 and 0.19t/ha respectively by increasing to 80 kg MAP/ha which equated to PGM increases of $19 and $50/ha.

Zone 5 soil test results best described this area and indicated low P reserves (DGT) and moderate/high PBI with greater responses occurring compared to zone 1 possibly due to higher PBI present in zone 1 and lower efficiencies of applied P. Changing MAP rates through VRT maps does make overall response to P/MAP rich strips difficult and a corresponding low P/MAP strip adjacent would improve interpretation of where increasing MAP rates will provide the best return on investment and PGM.

Table 2: Mean Grain yields for the different VRT zones illustrated in Photo 2 running west (top) to East (bottom) compared with the adjacent 80 kg MAP/ha and resulting PGM obtained using wheat grain price of $350/t and MAP at $1000/t (right).

VRT MAP (kg/ha)	Grain Yield (t/ha)	MAP rich (t/ha)	Grain Yield (t/ha)	VRT PGM ($/ha)	MAP rich PGM ($/ha)
40	0.559	80	0.634	155	142
65	0.741	80	0.795	194	198
40	0.728	80	0.896	215	234
65	0.834	80	1.019	227	277
60	0.914	80	0.927	260	244
25	0.869	80	0.914	279	240
Full run					
49	0.754	80	0.852	215	218



CONCLUSIONS

- Profitable increases in barley grain yield were obtained in certain paddock zones through increasing P rates through MAP.
- Zones that demonstrated the greatest response to extra P addition were identified through Google Earth and low relative NDVI signatures.
- Growers and advisors are encouraged to use zonal paddock approaches to identify different performing areas and investigate poor performing parts of the paddock before starting replacement fertiliser programs.
- Recent work has outlined that poor NDVI areas can be often associated with poor P reserves and can return a bounce in yield with increasing P inputs compared to the strategy of decreasing P inputs with overly simplified replacement P programs.

Australian Government Department of Agriculture, Fisheries and Forestry | Future Drought Fund | SA DROUGHT HUB | Mallee Sustainable Farming | AGRONOMY SOLUTIONS INDEPENDENT RESEARCH • QUALITY RESULTS

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PROJECT INFORMATION

Thanks to David and Anthony Schmidt for hosting the trial.

Demonstrating Soil Zone Mapping for Variable Rate Nutrition Management - DN4_23_05
Website Link: https://msfp.org.au/projects/demonstrating-soil-zone-mapping/

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