Precision Ag Trials

Evaluating the potential for P replacement strategies

Mildura, Victorian Mallee

PA tools have been available to Australian grain growers for many years, and the benefits have been well documented, it is estimated that less than 1-% of grain growers utilise PA 'beyond guidance' in any form.

The objective of this GRDC / SPAA funded project is to increase the level of adoption of PA 'beyond guidance' by broadacre farmers. The project specifically aims to increase the level of adoption of variable rate (VR) by growers in the project to 30% by 2013. This goal will be achieved by demonstrating how to use PA tools to growers at a regional level and by increasing the skills of growers and industry in PA to a level where they can then use PA tools in their farming systems to achieve economic, environmental and social benefits.

Trials and demonstrations are conducted on growers' properties and are visited throughout the season using farm walks and workshops to discuss the advantages and disadvantages of PA techniques with the involvement of other regional growers.

This information sheet presents the outcomes of the SPAA trial **Evaluating the potential for P replacement strategies** from season 2011.

Aims:

- To use PA maps to indentify and sample soil zones within a paddock
- To investigate soil phosphorus levels in different soil types with a paddock
- To see if altering fertiliser rates at sowing has an impact on grain yield

Background:

There has been widespread use of continuous cereal in the Mallee over the past decade, and with many drought years throughout this period fertiliser inputs have generally been greater than crop demand. As a consequence, soil phosphorus levels are often well above the critical level. By identifying soils and conditions where continuous cereal systems perform best and where inputs can be most effectively targeted, there is an opportunity to reduce input costs and increase profitability. This trial used PA methods to identify soil types for targeted soil sampling to achieve a greater understanding of soil phosphorus levels in different soil zones. Yield mapping was then used to identify if and where fertiliser applied to the crop impacted grain yield.

About the trial:

The trial paddock was located 25 km west of Mildura in the Victorian Mallee (Figure 1). The crop management details are listed below:

Crop type: Wheat

- **Variety:** Axe
- **Sowing Date:** 20th May 2010
- **Sowing Rate:** 30kg/hectare
- **Sowing Fertiliser:** DAP 10-50kg/hectare Variable Rate.

Figure 1. Location of the focus paddock

Fertiliser was applied at a variable rate with a Topcon X20 screen and Bourgult air cart. Fertiliser rates varied from 10 to 50 kg/ha. Fertiliser application maps were developed by the farmer from the prvious season's yield map.

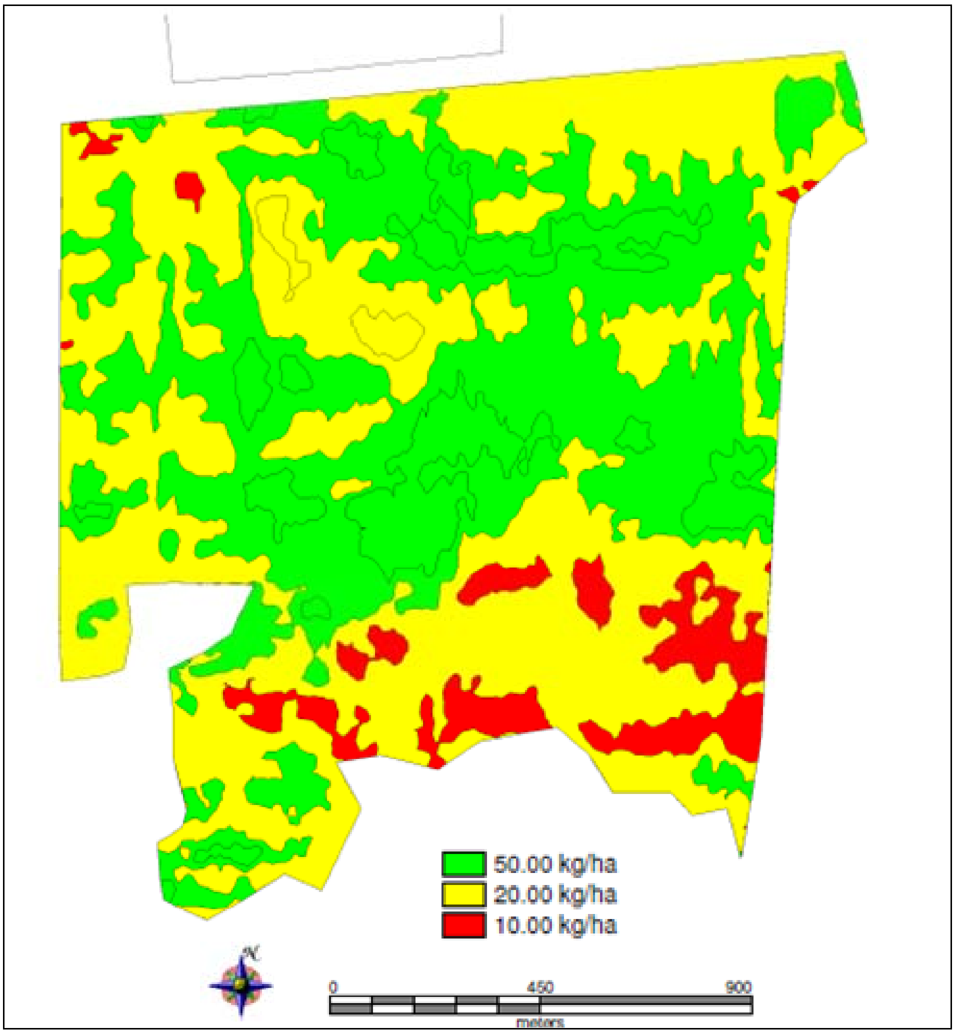

Figure 2. Fertiliser application map for the focus paddock.

The fertiliser application map was also used to select two soil sampling locations (dune and swale). At each location five soil cores to 1.2 m were collected and anaysed for soil water and nitrogen. The topsoil was also assesed for soil fertility.

Fertiliser treatments where applied in strips running the length of the paddock at sowing (Figure 3). Three rates were used:

- DAP @ 60 kg/ha
- DAP @ 30 kg/ha
- Nil Fertiliser

A control strip (no incrop fertiliser applied) was left either side of each treatment (Figure 3).

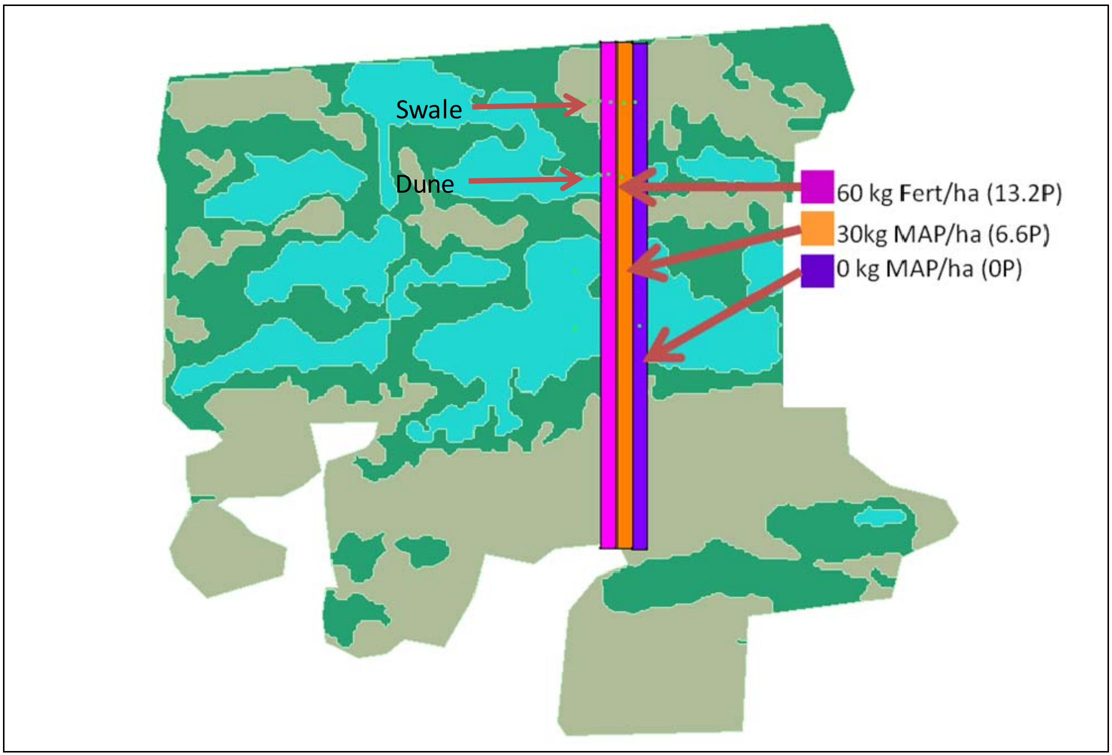

Figure 3. Zone map of the focus paddock showing the position of the treatment strips (60, 30 and Nil kg/ha of DAP)

Assessments:

The following soil parameters were measured for three soil types in the paddock:

- **Topsoil fertility (0-10cm):** Carbon, Phosphorus, Phosphorus Buffering index (PBI), Nitrogen, Potassium, Sulphur, pH and Electrical Conductivity (EC)
- **Subsoil (10-30, 30-60, 60-90, 90-120cm):** Nitrogen and soil water

Yield was also measured for each treatment. Yield was averaged in 20m sections for one header run closest to the middle of the treatment strip.

Results:

Soil testing prior to sowing revealed that chemical properties were highly variable between zones (Table 1). Over a distance of only 200 m between the dune and the swale, soil organic carbon levels tripled from 0.25% to 0.75%. Topsoil phosphorus levels also increased from 23 (Colwell) on the dune to 43 (Colwell) on the swale. However, phosphorus buffering capacity was low on the dune (25) but high on the swale (110), which means that higher phosphorus levels are required on the swale to avoid phosphorus deficiencies in crop.

Soil nitrogen levels were vastly different between the two zones (Table 2). On the swale, 270 kg/ha was present to 1.2m, while on the dune only 84 kg/ha of nitrogen was measured in the root-zone.

Table 1. Topsoil (0-10 cm) soil test results for the dune and swale sampling locations

Test		Dune	Swale
		0-10	0-10
Organic Carbon	%	0.25	0.78
Ammonium N	mg/Kg	2	1
Nitrate N	mg/Kg	12	25
P (Colwell)	mg/Kg	23	43
K (Colwell)	mg/Kg	323	634
S	mg/Kg	4.42	7.02
Conductivity	dS/m	0.074	0.320
pH ($CaCl_2$)	pH	7.9	8.1
PBI		25	110

Table 2. Nitrogen levels (to 1.2 m) and plant available water at sowing for each soil zone.

Soil Type / Zone	Soil Nitrogen (kg/ha)	Plant Available Water (mm)
Swale	270	36
Dune	84	41

The focus paddock yields were highly variable and ranged from 1.3 – 3.0 t/ha (Figure 4). The highest yielding zones of the paddock were the sandy loam soil types that run through the centre of the paddock, followed by the sandy dunes, with the heavy flats (clay loam soils) having the poorest yields. The 2010 season was excellent with growing rainfall above decile 9 (Figure 5).

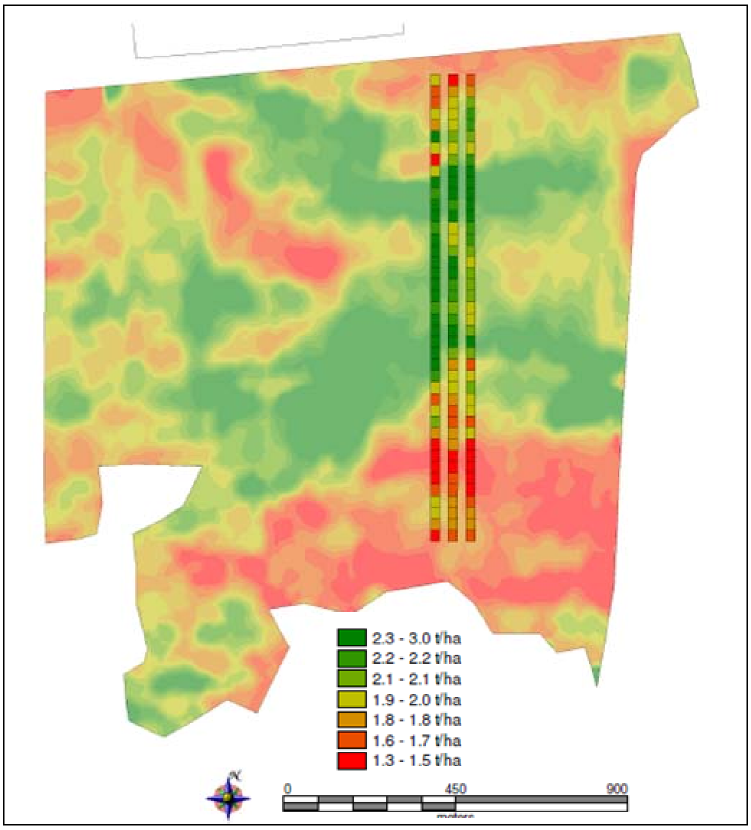

Figure 4. 2010 Focus paddock yield map showing the three treatment strips (Left 60 kg/ha DAP; Middle 30 kg/ha DAP; Right Nil Fertiliser).

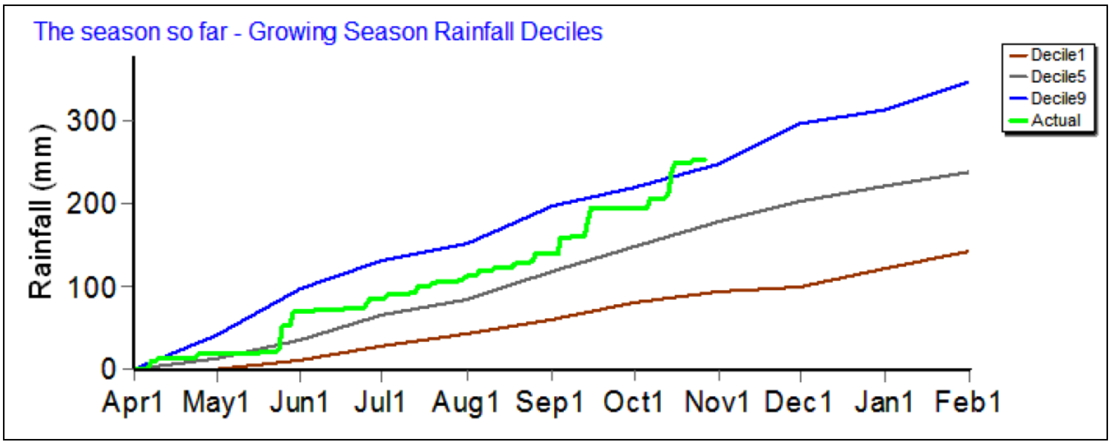

Figure 5. 2010 growing season rainfall decile for Mildura Airport

Figure 6 compares the yields of the three treatment strips across the paddock. It appears that additional fertiliser had the greatest effect in the sandy loam section of the paddock, variable impact on the sandy dunes and little impact on the clay loam flats. By comparing Figures 4 and 6 with the fertiliser application map in Figure 2, we can see that maintaining high fertiliser rates at sowing on the sandy and sandy loam soils of the paddock is justified. However, reducing fertiliser inputs on the flats is also a valid management strategy in this paddock as there is little evidence of a yield response on clay loam soils.

The response to additional fertiliser on the sandy loam soil zone was approximately 0.2 t/ha per 30 kg/ha of DAP. At a grain price of $210/t and a DAP price of $750/t, applying the fertiliser on the sandy loam soil type increased profit by approximately $20/ha in the 30 kg/ha treatment and $40/ha in the 60 kg/ha treatment. Phosphorus supplied through DAP cost approximately $4 per kilogram of P and 5.4 kg/ha of P are supplied for each 30 kg/ha of DAP applied. However, if the yield response was attributed to the nitrogen component of DAP, then the cost of the nutrient would be $7.50 per kilogram of nitrogen supplied through the DAP (3 kg/ha N supplied with 30 kg/ha of DAP). This nutrient can be supplied at the much lower cost of $1.40 per kilogram of nitrogen by using urea at a cost of $650/t. Therefore further work is required in this paddock to identify if the phosphorus, nitrogen or a combination of the two nutrients is providing the yield response.

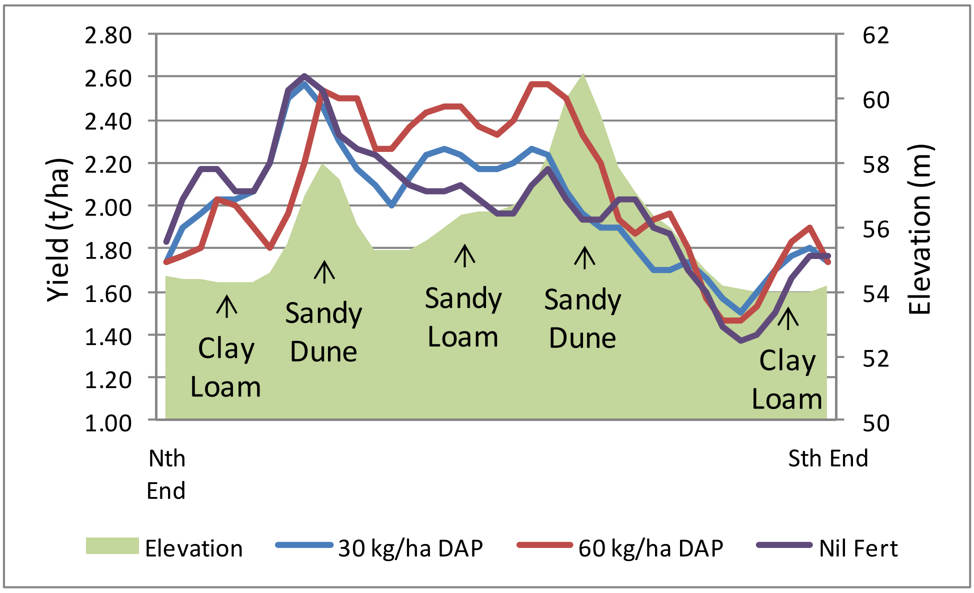

Figure 6. Comparison of the yields of the three treatment strips from north to south. Yields were averaged for 20m blocks of two header widths in the middle of the treatment. Each 20m block was then averaged with the two blocks either side to create a moving average of 60m. Elevation recorded by the header (RTK 2cm) has been plotted in the background.

Who was involved?

Colin and Chris Hunt, Collaborating farmers, Mildura

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Grower/Regional feedback:

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