Precision Ag Trials

Soil Type Specific Nitrogen Responses

Ouyen, 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 **Soil Specific Nitrogen Responses** from season 2010.

Aims:

- To use PA maps to indentify and sample soil zones within paddocks
- To identify potential soil specific nitrogen responses within paddocks

Background:

There has been widespread use of continuous cereal in the Mallee over the past decade and one of the major issues associated with this system is the risk associated with the high nitrogen requirements of intensive cropping. 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 risk and increase profitability. This trial used PA methods to identify soil types for targeted soil sampling to achieve a greater understanding of potential crop responses to nitrogen fertilisers in different soil zones.

About the trial:

The trial paddock was located south of Ouyen in the Victorian Mallee (Figure 1). The crop management details are listed below:

Crop type: Wheat

- **Variety:** Yitpi
- **Sowing Date:** 20th May 2010
- **Sowing Rate:** 75kg/Ha
- **Sowing Fertiliser:** D.A.P/SOA 60kg/Ha

Figure 1. Location of the focus paddock

Fertiliser was applied at a variable rate with fertiliser inputs ranging from 55-65 kg/ha. Product application was controlled with a Topcon X20 and liner actuators fitted to the simplicity aircart. Zone maps were developed from EM38 maps where high EM correlated to the heavy soils in the paddocks and low EM correlated to the sandier soil types. The low EM zones recvied the higher seeding and fertiliser rates.

Historic Normaised Differential Vegitation Index (NDVI) was used to map soil types and select soil sampling locations (Dune – light sandy soil; Midslope – sandy loam & Swale – clay loam). At each location five soil cores to 1.2 m were collected and anaysed for soil water, nitrogen and subsoil contriaints. The topsoil was also assesed for soil fertility. The soil characterisitics were used in Yield Prophet to determine the yield potential and nitrogen requirements for crops growing on the three soil types in the paddock.

Two Nitrogen Rich Strips (N Rich strips) were applied to the focus paddock on the 1st of July 2010. The two N Rich treatments were applied:

- Urea (100 kg/ha)
- Urea (50 kg/ha)

A control strip (no incrop fertiliser applied) was left either side of the three treatments.

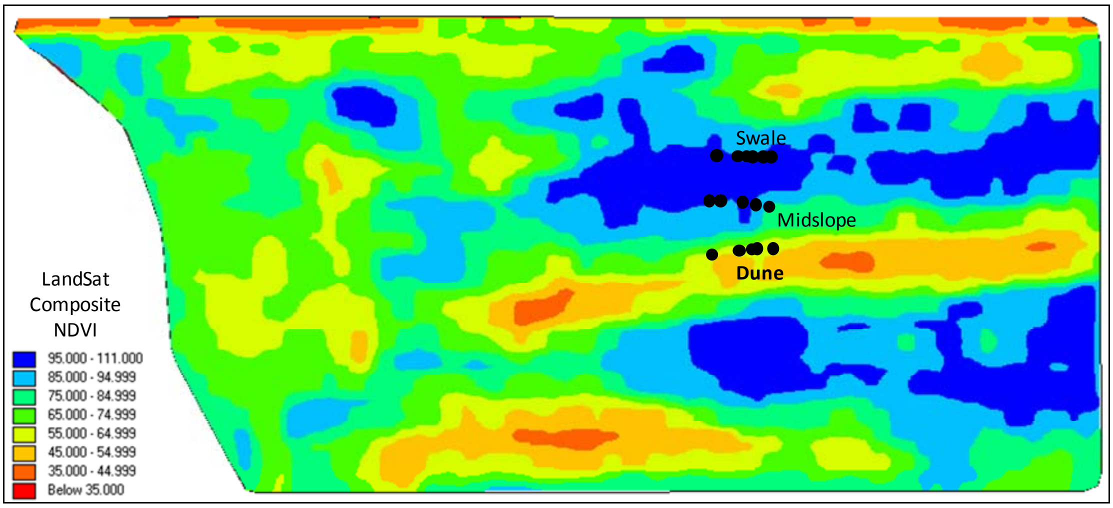

Figure 2. Normalised Differential Vegetation Index (NDVI) map of the focus paddock including soil sampling locations (Dune, Midslope and Swale)

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 and the control strips located on either side of each treatment.

Results:

Soil testing prior to sowing revealed that chemical properties were highly variable between zones (Table 1). For example, over a distance of 100 m between the midslope and the swale, soil organic carbon levels nearly doubled from 0.22 to 0.40. Topsoil phosphorus levels also increased from just above the marginal level of 20 (Colwell) on the midslope to nearly 30 (Colwell) on the swale. Topsoil fertility on the dune zone was expected to be much lower than the testing revealed. This soil type had the highest organic carbon levels (0.57%) and phosphorus levels (Colwell P = 40). However, the top of the dune where the soil samples were collected has historically been eroded and this may have influenced the results.

Soil nitrogen and plant available water levels differed between the three zones (Table 2). The zone of the highest yield potential was the midslope with 105 kg/ha of nitrogen and 51mm of plant available water prior to sowing. The sandy dune had slightly less nitrogen and water, while the swale had much more soil nitrogen (179 kg/ha) but little subsoil moisture.

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

Top Soil Analysis				
Test		Dune	Midslope	Swale
		0-10	0-10	0-10
Organic Carbon	%	0.57	0.22	0.40
Ammonium N	mg/Kg	10	4	5
Nitrate N	mg/Kg	7	2	3
P (Colwell)	mg/Kg	40	20	29
K (Colwell)	mg/Kg	504	231	314
S	mg/Kg	10.7	3.91	6.2
Conductivity	dS/m	0.14	0.097	0.10
pH ($CaCl_2$)	pH	7.9	8.0	7.8
PBI		62.5	30.9	19.6

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	179	7
Midslope	105	51
Dune	83	46

Yield Prophet was used to assess yield potential for each sampling location (Figure 3). A report run on the 29th of July indicated that there could be a response to nitrogen in 50% of years on the dune and 20% of years on the midslope. However, there was little prospect of a nitrogen response on the swale.

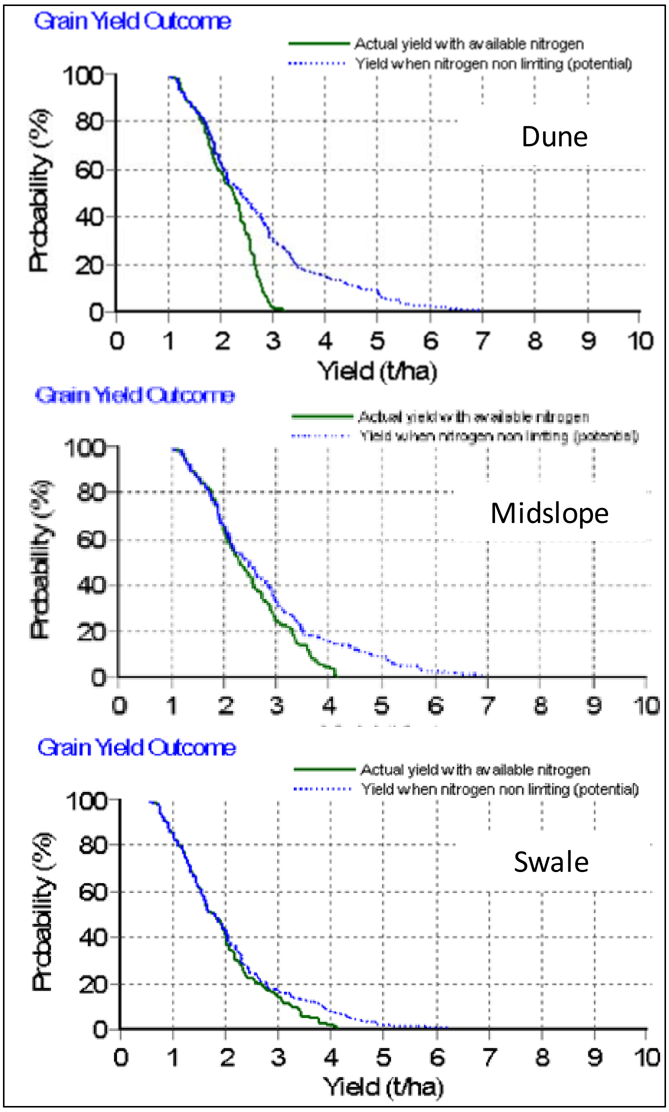

Figure 3. Yield prophet yield potential predictions for the Dune, Midslope and Swale on the 29th of July 2010.

The focus paddock yields were highly variable and ranged from 0.5 – 5.6 t/ha (Figure 3). The 2010 season was well above average with high levels of spring rainfall (Figure 4). The highest yielding zones in the paddock were loam and heavy swale soil types and in general the sandy dune soil preformed the worst (Figure 5). As shown in Figure 4, in the area where the midslope and swale Yield Prophet reports were run, grain yields were 3.25 – 3.5 t/ha. However, on the Dune final yields were 2.75 -3 t/ha. As growing season rainfall was decile 8 (Figure 5), the Yield Prophet report run on the 29th of July did an excellent job at predicting potential yield outcomes for the different soil zones (decile 8 = 20% probability in Figure 3).

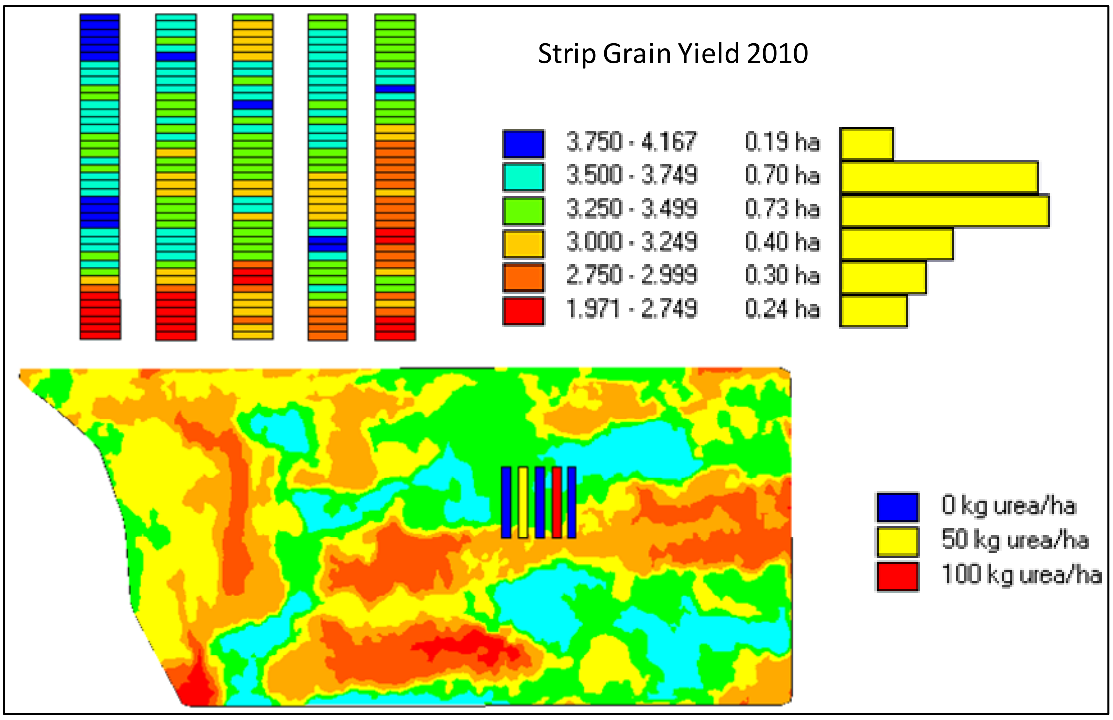

Figure 4. Focus paddock yield map (2011) showing the treatment strips of Urea (50 kg/ha and Urea (100 kg/ha). Control strips (no in-crop fertiliser) are located either side of the trial strips.

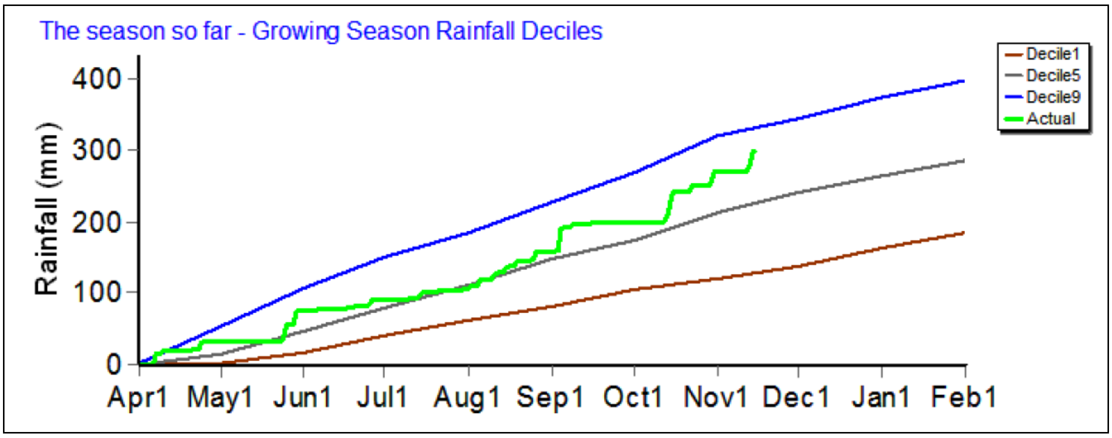

Figure 5. Growing season rainfall deciles for the Ouyen Focus Paddock in 2010.

Urea strips (50 and 100 kg/ha) were applied across the area where the zones were soil sampled; however, few differences in grain yield could be attributed to nitrogen fertiliser application. The clearest impact was an increase in grain yield of 0.2 – 0.6 t/ha in the region between the dune and midslope soil sampling locations. However, the area where there appeared to be a yield response was only ¼ of the total area where nitrogen was applied.

The maximum response to nitrogen was low with 8 kilograms of grain returned per kilogram of nitrogen at the 50 kg Urea/ha rate, and 13 kilograms of grain per kilogram of nitrogen for the 100 kg Urea/ha rate. Considering only additional yield income at a grain price of $210/t and fertiliser costs (urea at $620/t), applying a 50 kg/urea returned a maximum profit of $11/ha while applying 100 kg/urea returned a maximum profit of $64. However, if the fertiliser was applied to the whole paddock significant losses would have been incurred. Therefore applying nitrogen to this paddock in this season would have only been economically viable with the use of paddock zoning and targeted inputs.

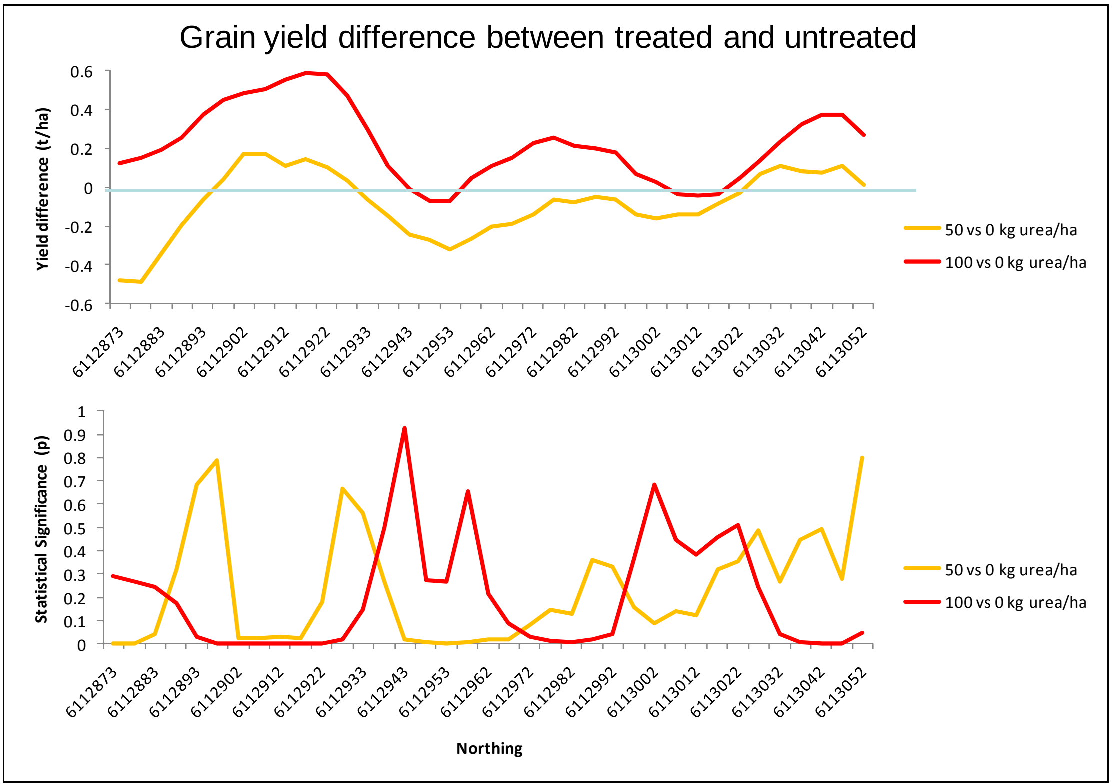

Figure 6. Grain yield differences (top) and paired T-Test significance (bottom) for the 50 and 100 kg/ha of urea strips compared to the nil fertiliser treatments wither side.

Who was involved?

Scott and Vanessa Anderson, Collaborating farmers, Ouyen

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Grower/Regional feedback:

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