Precision Ag Trials

Soil Type Specific Nitrogen Responses

Ouyen, Victorian Mallee

Although 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 2011.

Aims:

- To use PA maps to identify and sample soil zones within a paddock
- To identify potential soil specific nitrogen responses within paddocks
- To compare different nitrogen fertiliser products

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. Furthermore, the collaborating farmers were interested in comparing the crop responses achieved by applying different fertiliser sources.

About the trial:

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

This year's crop type: Wheat

- **Variety:** Gladius
- **Sowing Date:** 18th May 2011
- **Sowing Rate:** Variable Rate: 60 -75kg/Ha
- **Sowing Fertiliser:** Variable Rate: D.A.P/SOA 50 - 80kg/Ha

Figure 1. Location of the focus paddock

Both seed and fertiliser were applied variable rate with seeding rates ranging from 60-75 kg/ha and fertiliser rates ranging from 50-80 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 received the higher seeding and fertiliser rates.

The EM38 map was also used to select soil sampling locations (Dune – light sandy soil; Swale – clay loam soil & Loam/Limestone rise –sandy loam soil over limestone at xx cm depth?). At each location five soil cores to 1.2 m were collected and analysed 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.

Nitrogen Rich Strips (N Rich strips) were applied to the focus paddock on at growth stage 30. Three N Rich treatments were applied:

- Urea (90 kg/ha)
- UAN (100 L/ha)
- Urea/Sulphate of Ammonia (SOA) blend (70%/30%) (110 kg/ha)

All three products supplied the crop with aprroximalty 42 kg/ha of nitrogen with the Urea/SOA blend also supplying the crop with approximalty 8 kg/ha of sulphur. A control strip (no in crop fertiliser applied) was left either side of the three treatments (Figure 3).

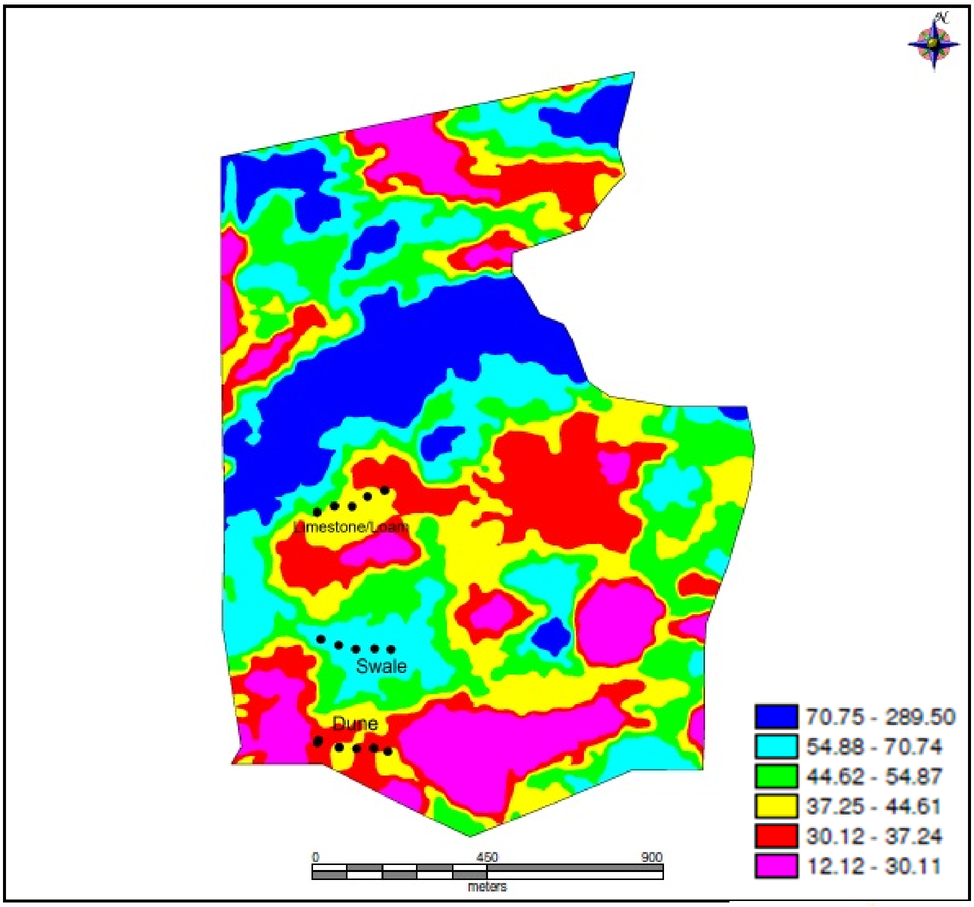

Figure 2. EM38 map of the focus paddock including soil sampling locations (Dune, Swale and Loam soil types)

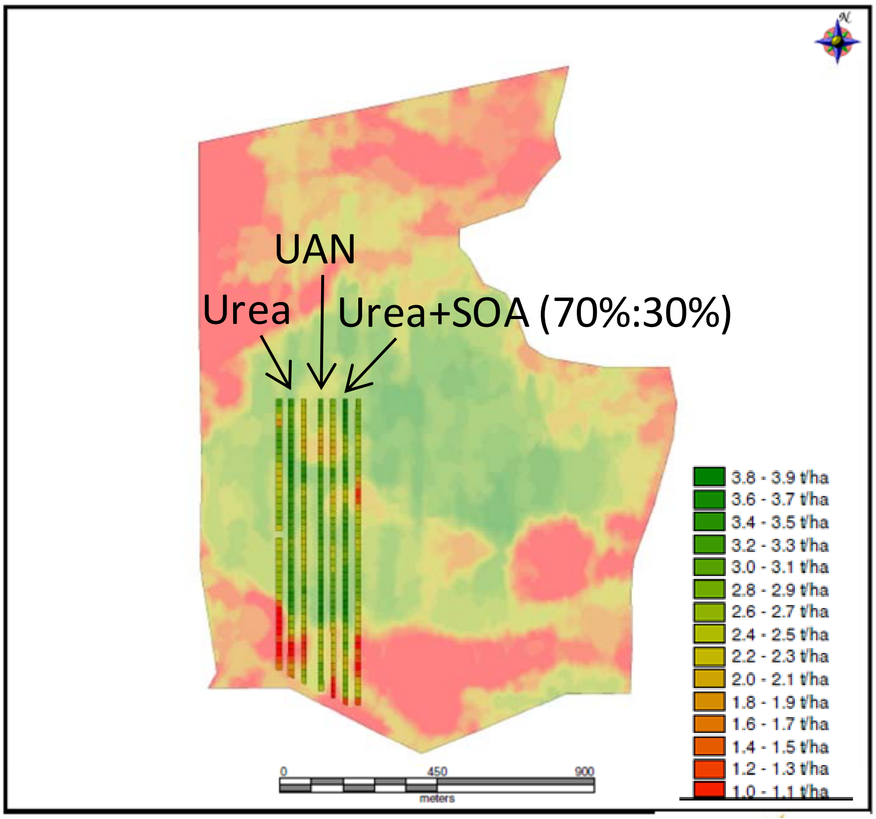

Figure 3. Focus paddock yield map (2011) showing the treatment strips of Urea (90 kg/ha), UAN (100 L/ha) and Urea/Sulphate of Ammonia (SOA) blend (70% Urea, 30% SOA). Control strips (no in-crop fertiliser) are located either side of the trial strips.

Assessments:

The following soil parameters were measured for the 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, pH, EC, Boron and Chloride

Yield was also measured for each treatment and the control strips located on either side of 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 soil nitrogen levels were vastly different between the three zones however plant available water levels were more consistent between soil types (Table 1). Subsoil constraints were also expected on the heavy soils (loam and swale) however soil testing to 1.2 m did not reveal any chemical constraints to rooting depth in any of the zones.

Table 1. 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	112	95
Loam/Limestone Ridge	62	132
Dune	32	126

The focus paddock yields were highly variable and ranged from 1 – 3.9 t/ha (Figure 3). The 2011 season was characterised by record summer rainfall followed by a dry growing season. However the summer rainfall resulted in high sub-soil moisture levels prior to seeding.

Figure 4. The photo shows the visual crop response to the N Rich strips

The highest yielding zones in the paddock were loam and heavy swale soil types and in general the sandy dune soil performed the worst. There was a clear visual effect of applying nitrogen in this paddock (Figure 4). Figures 5 – 7 show that applying nitrogen generally had a positive impact on yield and this was consistent across all soil zones. On average, applying 42kg/ha of nitrogen increased yields by approximately 0.75t/ha which is a nitrogen efficiency of approximately 18 kilograms of grain returned per kilogram of nitrogen applied. At a urea cost of $620/t and a grain price of $210/t (delivered port), applying an additional 42kg/ha of nitrogen to this paddock generated an extra $96/ha profit for the farmer.

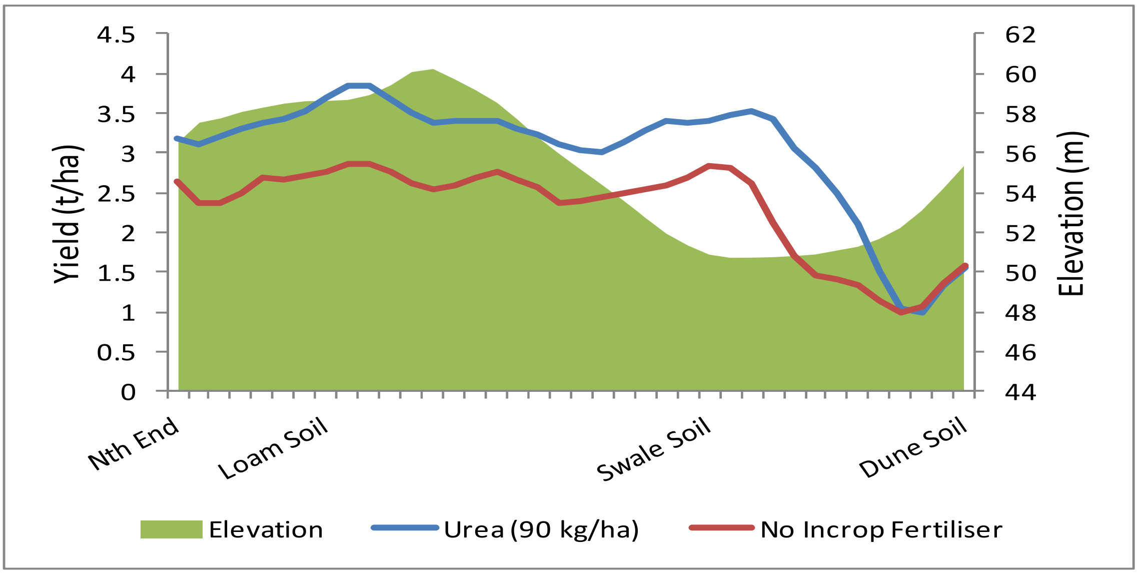

Figure 5. Yields of the urea treatment along the trial strip compared to the average yield of the two no fertiliser treatments either side. Yields were averaged for 20m blocks of one header width in the middle of the treatment. Each 20m block was then averaged with the two blocks either side to create a moving average of 60m. Elevation recorded by the header has been plotted in the background.

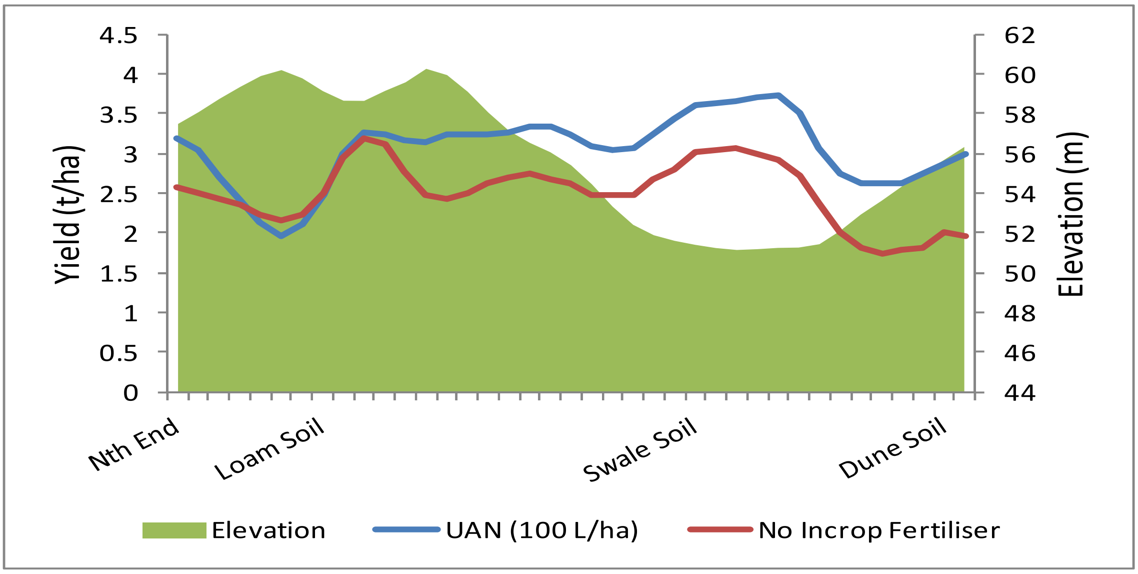

Figure 6. Yields of the UAN treatment along the trial strip compared to the average yield of the two no fertiliser treatments either side. Yields were averaged for 20m blocks of one header width in the middle of the treatment. Each 20m block was then averaged with the two blocks either side to create a moving average of 60m. Elevation recorded by the header has been plotted in the background.

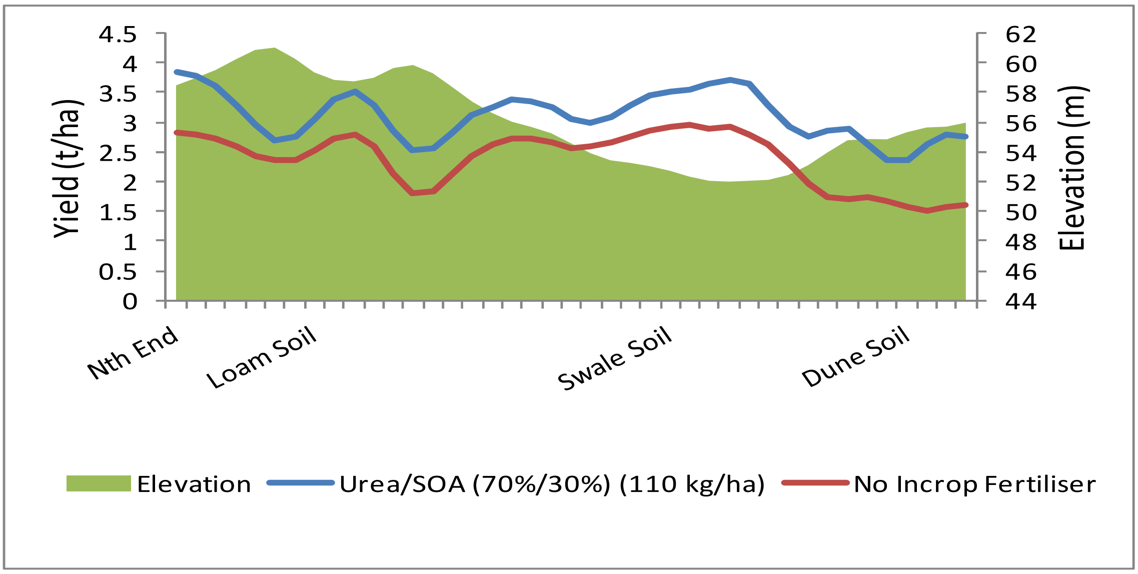

Figure 7 Yields of the urea treatment along the trial strip compared to the average yield of the two no fertiliser treatments either side. Yields were averaged for 20m blocks of one header width in the middle of the treatment. Each 20m block was then averaged with the two blocks either side to create a moving average of 60m. Elevation recorded by the header has been plotted in the background.

While all soil types responded to nitrogen, the response and profitability of nitrogen application varied between soil zones. Using the Urea/SOA treatment as an example, for the loam and swale soil types, the additional profit compared to no in-season N was approximately $50/ha. However, applying additional fertiliser to the dune soil was twice as profitable (approximately $100/ha).

As input costs were standard across all soil types (i.e. an N Rich strip with the equivalent rate of N was used for all treatments), profitability was driven by the increase in yield (Figure 8). As fertiliser efficiency was below its potential for the loam and swale soils (and at potential for the dune soil), it is possible that the same yield response could have been achieved with less fertiliser, therefore these two soil zones could have been more profitable if less nitrogen was applied.

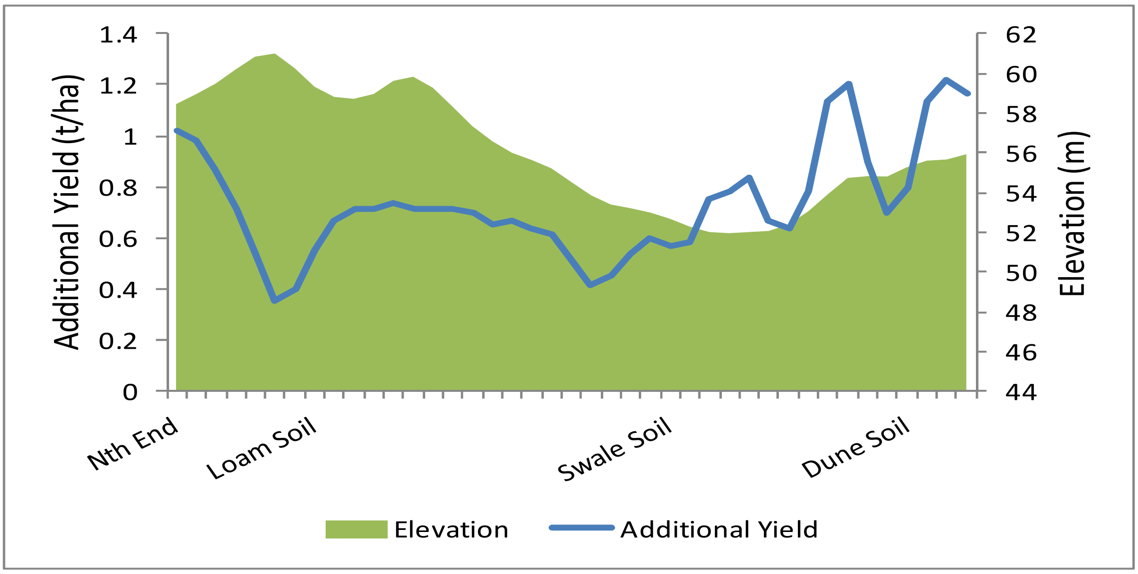

Figure 8. Additional yield generated through the application of nitrogen fertiliser (Urea/SOA treatment).

The trial investigated three nitrogen fertiliser sources; urea, UAN and a blend of urea and ammonium sulphate. Despite some abnormalities in some sections of the trial strips (such as on the dune in the urea treatment and on the loam soil in the UAN treatment), all three nitrogen fertilisers were equally effective in this trial.

Who was involved?

Scott and Vanessa Anderson, Collaborating farmers, Ouyen

Michael Moodie, Mallee Sustainable Farming

Grower/Regional feedback:

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