Precision Ag Project; "Increasing Precision Agricultural Awareness and Adoption in South East of South Australia"

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Introduction:
Precision Agriculture (Precision Ag) is a concept that relies on the existence of variability across farms & fields. The benefits from implementing Precision Ag Techniques depends on the amount of variability that exist within a farm/field & also the ability to utilise this variation to obtain some economic outcomes.

Aim:
The aim of the project was to increase the understanding and awareness of how spatial measurement tools (EM38 mapping, Imagery data, RTK Elevation Data & Yield Mapping) can be utilised to identify variations in soil capabilities & to then demonstrate how management can potentially be changed over these areas & the economics of implementing these changes.4 of the 6 sites were looking at changes in Nitrogen management over the demonstration paddocks, another site focussed on varying rates of gypsum & the final site looked at seeding rates & varieties in broad beans.

Method:
All sites were surveyed in Feb/March 2009 with an EM38 machine which measured changes in the conductivity of the soil. The figure that was recorded is a relative figure that was then calibrated using site specific soil coring.
The EM38 soil surveys carried out at the sites at Coonawarra, Conmurra & Padthaway showed a strong correlation between the EM38 reading and the physical properties of the soil (depth to either calcrete layer/limestone). This has potential implications on the drainage of water, total water holding capacity & trace-element nutrition of the crop.
The EM38 soil surveys at Frances, Bordertown & Apsley were more strongly correlated to chemical properties of the soil, with factors like ESP (Exchangeable Sodium percentage), Boron content and Calcium:Magnesium ratios driving the EM38 readings. These chemical factors can affect the structural stability of the soil & also the ability of the plant to extract water (particularly under drier conditions).

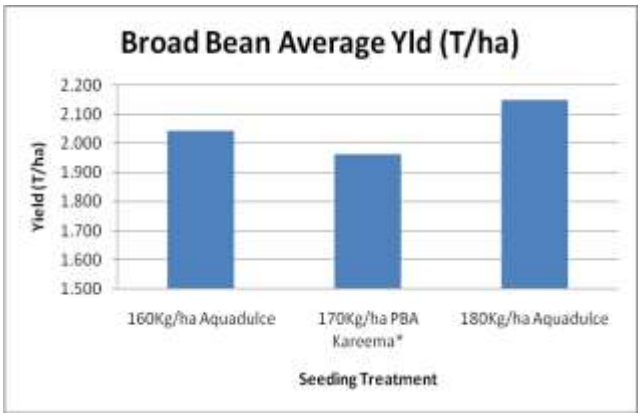
The sites were then measured with a "Greenseeker" – a machine that measures the NDVI (Greenness) of the crop. The Greenseeker machine can also automatically generate a recommended rate for Nitrogen application based on the "greenness" relative to crop growth. This map was used to determine variable rate applications that were applied in Canola at Padthaway & in wheat at Coonawarra. At other sites, varying rates across different soil types were compared with standard farmer practice.
Yield data from farmer / contractors yield monitors was then collected post-harvest & analyses carried out to measure the economic response of varying management practices across different soil zones.

Results by site....

Conmurra; Broad Beans - Seeding Rates & Variety

New Broad Bean Variety PBA Kareema was compared in farm-scale demonstration strips to traditional variety Aquadulce. Farmer seeding rates of Aquadulce were also varied to try and assess if current seeding rates (160kg/ha) are optimal (Table 1).

Graph 1: 2009 Seeding Treatments across paddock



* PBA Kareema was sown 7days after Aquadulce treatments
170Kg/ha rate of PBA Kareema targeting equivalent plant densities to 160Kg/ha rate Aquadulce (Kareema was slightly smaller seed)

As part of the demonstration, seeding treatments were looked at across 3 soil "zones" as determined by an EM38 survey to see if there were any economic benefits in using different seeding rates across different soil types. These results are outlined in Table 1. The soil "zones" reflected the depth of soil fairly well, with Zone1 being a shallow soil, Zone2 having a greater depth of soil with limestone appearing at 50-60cms and Zone3 consisting of soil with no limestone present through the profile to 1m.

Table 1: Optimum Seeding Rate by Soil Zone

Seeding Rate (Aquadulce)	Soil Zone	Yield (T/ha)
160	1	1.901
180	1	1.942
160	2	2.151
180	2	2.312
160	3	1.898
180	3	1.727

By varying seeding rates across soil zones (ie.180kg/ha in zones 1&2 and 160kg/ha in zone3) in 2009 across the whole paddock (71ha) would have resulted in an additional return of $9.80♦/ha

♦Assumes seed & grain costs of $450/Tonne

Additional Comments:
2009 Results showed potential benefits of VR seed application across different soil zones, but only if farmers already have equipment that is already VR enabled.

Bordertown; Wheat – Nitrogen Response

Varying rates of Nitrogen were applied at GS30 to compare responses of different Nitrogen rates to farmer practice and also to look at how the response varied across soil zones during 2009 to improve understanding of how variable rate may be applied.

Standard farmer practice was to apply 100Kg/ha Urea (46Kg N/ha) at GS30. Graph1 below outlines the response across the paddock to varying rates;

Graph 2: Yield Response to Nitrogen

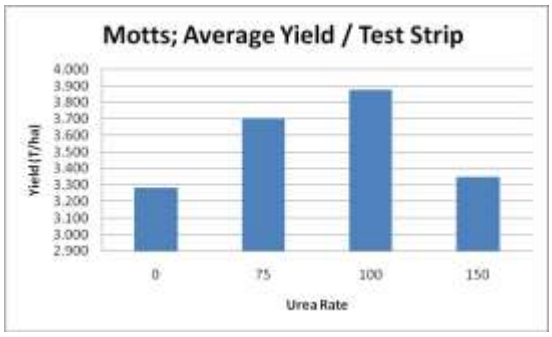


Table 2: Economic Response to N

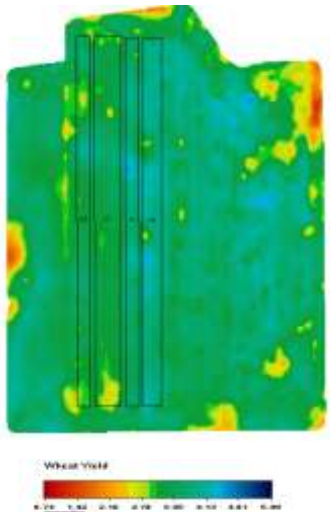
Urea Rate	Return/ha (vs std practice)
0	-$ 34.67
75	-$ 13.18
100	$ -
150	-$ 138.75

The Varying Urea rates were then compared across different soil zones to see if different soil zones responded differently to varying rates of Nitrogen and assess the economics of variable rate nitrogen management within the field.

Zones 1-4 were found to have an "ideal" Urea rate of 75Kg/ha, with zones 5-7 having an "ideal" Urea rate of 100Kg/ha ("Ideal" rate being the rate in each zone that returned the highest gross margin).

If the site was fertilised at the "ideal" rate for each zone in 2009, then variable rate nitrogen application in this paddock at GS30, would have returned an additional $28.06/ha across a 50ha paddock compared to a flat rate of 100Kg/ha Urea.

Figure 1: 2009 Wheat Yield with Test Strip location



Additional Comments:
EM38 was strongly correlated to subsoil constraints (high ESP and high Boron). In seasons where moisture is limiting, these higher EM areas may not respond as well to high Nitrogen applications.

Coonawarra; Wheat – Nitrogen response based on NDVI

Economics of applying Nitrogen in a wheat crop based on results of a Greenseeker Sensor Logarithm were compared to standard farmer application.

Greenseeker Data was collected at GS32 and related to an "N-rich" strip to establish application rates based on the NDVI ("Greenness") of the crop. Due to technical issues in getting the equipment to apply a variable rate map, the rates were determined on an average of what the Greenseeker algorithm suggested across the strip (55L/ha EasyN). This rate was compared to standard farmer rate (65L/ha EasyN) & a rate determined utilising both the Greenseeker data & the EM38 map (76L/ha EasyN). A strip with no nitrogen was also applied. The end yield data was then assessed. Figure 2 shows the Greenseeker NDVI results & the location of the Test Strips.

Fig 2:Greenseeker NDVI and Test Strip Location

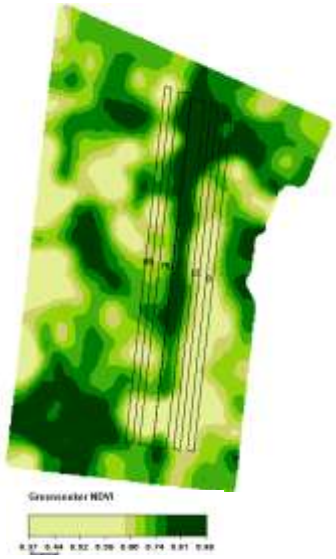


Table 3: Return/ha vs standard farmer practice

Rate method	Easy N (L/ha)	Average Wheat Yld (T/ha)	Return/ha (vs std practice)
Nil treatment	0	4.705	$ 36.48
GS Algorithm	55	4.734	$ 0.73
Farmer Practice	65	4.773	$ -
GS & EM Data	76	4.972	$ 25.72

The strip where no EasyN was applied returned the greatest profit, followed by the highest rate (76L/ha) where nitrogen rates were worked out by combining NDVI & EM Data.

Additional Comments:
This site is planned for barley in 2010; Nitrogen management will continue to be investigated to see what outcomes occur under different seasonal conditions.

Padthaway; Canola – VR Nitrogen response

The economics of applying Variable Rate Liquid Stimulus based on the results of Greenseeker Sensor logarithm were compared to standard farmer application (Granular Stimulus) and the resultant yield data collected to measure response.

Figure 3: VR Application map

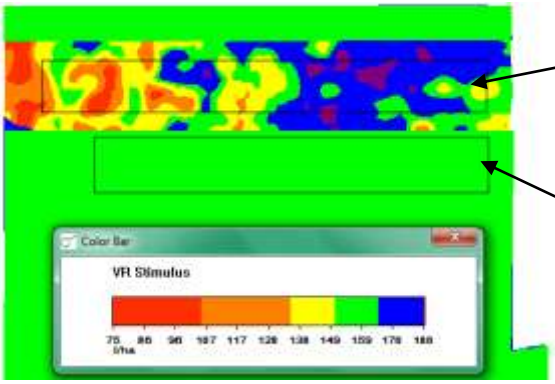
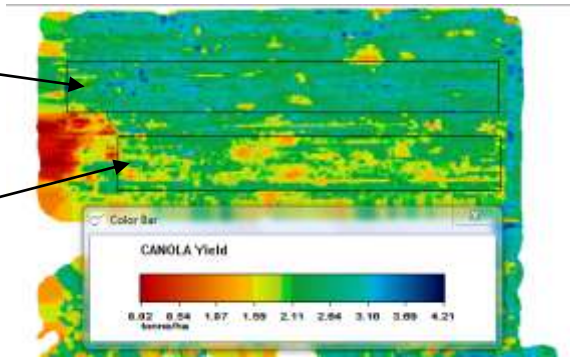


Figure 4: Canola Yield



The NDVI data was collected on 29/7/09 and the application was made on 18/8/09. The average rate (based on sensor data) applied in the Liquid application was 147L/ha Liquid Stimulus (39.7Kg/ha N). The standard farmer practice is 160Kg/ha Granular Simulus & this was applied at the same time on the rest of the paddock (48Kg/ha N). Table 4 outlines the results.

Table 4: Economics of VR Stimulus

Nitrogen application	Rate/ha	Product cost/ha	Average Canola Yld (T/ha)
Granular Stimulus	160 Kg/ha	$96.00	2.006
Liquid Stimulus - VR	147 L/ha	$176.40*	2.600

In this case, the Variable Rate application of Liquid Stimulus in Canola returned an additional $187/ha* over the standard farmer practice of a Granular application.

**Assumes Canola Price $500/T; Granular Stimulus $600/T; Liquid Stimulus $1.20/L*

Additional comments:
The soil factors did not appear to have any major affects on yield at this particular site under 2009 seasonal conditions. The site will be monitored over the next few years to see if varying seasonal conditions affect the soil x yield interactions.

Key Findings to date at other sites;

Environmental conditions affected the other sites; unusual levels of rain were received at the end of Spring causing large areas to go underwater and effecting results at sites. In these cases, topographic factors were the greatest drivers of yield due to excessive waterlogging in some areas.
For this reason, the data is being treated with some caution, as the actual outcomes are not clear and may not be reflective of future management choices.
Some of the key findings throughout the season at these sites are listed below;

- Frances: EM38 Survey was strongly linked to moisture that hadn't been utilised by the crop in 2008. The soils that were extremely high in moisture (& high in EM) were the loamy soils with the impenetrable hard-setting layer. These are the soils that are targeted for deep-ripping. *The potential exists to utilise EM38 surveys in determining where deep ripping is required within a paddock.*

- Apsley: Standard gypsum application across the paddock spread at 2.5T/ha; Test strips applied at 5T/ha & 10T/ha. The 5T/ha strips were consistently higher in the Greenseeker NDVI ("greenness") than the standard 2.5T/ha application, suggesting increased plant vigour at the higher gypsum rate.