Using Precision Farming Tools in Paddock Scale Trials

by the Birchip Cropping Group

SUMMARY

Precision farming tools such as EM surveys and yield mapping can add greatly to our understanding of grain yield and quality variation across a paddock. The results of N fertiliser and sowing rates on Silverstar wheat demonstrated that:

- grain yield differences are determined by soil type
- high sowing rates can contribute to lower screenings but does not guarantee lower screenings.

The large scale trial work raised issues on how to interpret small scale plot work. There is a greater need for researchers and farmers to work together towards identifying and interpreting paddock variability, before large scale, and often costly, management practices are put in place.

The aim of this work was to put into practice one of the key findings from the BCG research work over the last three years – 'high sowing rates in Silverstar wheat will decrease screenings'. At the same time it was a good opportunity to test the results of small scale plot work in a real life situation on a large scale.

METHODS

Sowing rate and Urea rates were tested on a whole paddock on the property of Ian and Warrick McClelland north of Birchip. The paddock is 650 x 800m in size.

Paddock History and trial layout

Three sowing rates and two urea rates were applied in opposite directions:

- 3 sowing rates – 52kg/ha, 72kg/ha and 102 kg/ha, six widths of the air seeder for each treatment sown east-west (repeated two times for each sowing treatment)
- 2 rates of Urea – 0 and 80kg/ha (38kg/ha nitrogen), six widths of the air seeder pre-drilled north-south (repeated four times for each urea treatment) (see Figure 1).

The paddock was in Ouyen wheat in 1998, and oats and medic in 1999 and heavily grazed throughout the season. In 2000, the paddock was sown with Silverstar wheat on May 28 with MAP at 50kg/ha.

Trifluralin was not used in the paddock and the heavier soil type areas in the paddock had sufficient ryegrass to cause some loss in yield. On the lighter soil types capeweed and mustard were a problem and the whole paddock was sprayed with MCPA LVE, Ally and Lontrel.

RESULTS

Rainfall

The average growing season rainfall (GSR) for the area is 240mm and the average yearly rainfall is 350mm. The 2000 season had average rainfall over the growing season (Table 1). Stored water at the start of the growing season was 33mm (calculated using the PyCal program). The expected yield in 2000 (calculated from stored water and growing season rainfall) was 3.5 t/ha.

Table 1. Rainfall mm (November 1999 to October 2000)

Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct.	GSR	Total
54	46	0	38	10	48	32	17	39	20	42	57	254	401

Measurements and observations

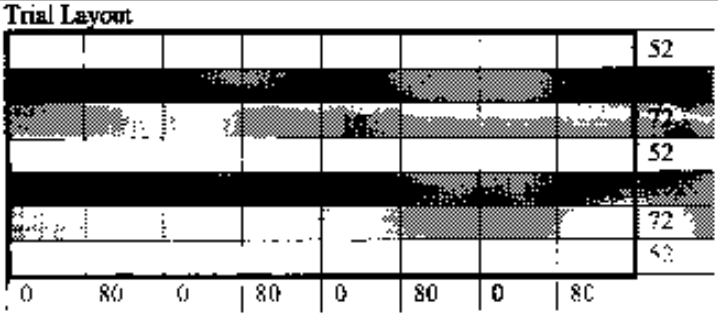
EM 38 Survey map - An Electro-Magnetic survey was conducted pre-sowing. The EM38 survey shows changes in soil electrical conductivity across the paddock (see Figure 1). The EM38 survey measures EC (electrical conductivity) changes down to 1.5m. Electrical conductivity in the soil is influenced by soil moisture and total salt levels.

Soil Map - The McClellands drew a map identifying changes in soil type across the paddock (see Figure 1).

Yield Map - A yield map of the paddock was generated at harvest (see Figure 1).

Figure 1. Trial layout and paddock observations

Trial Layout



Sowing rates: east / west

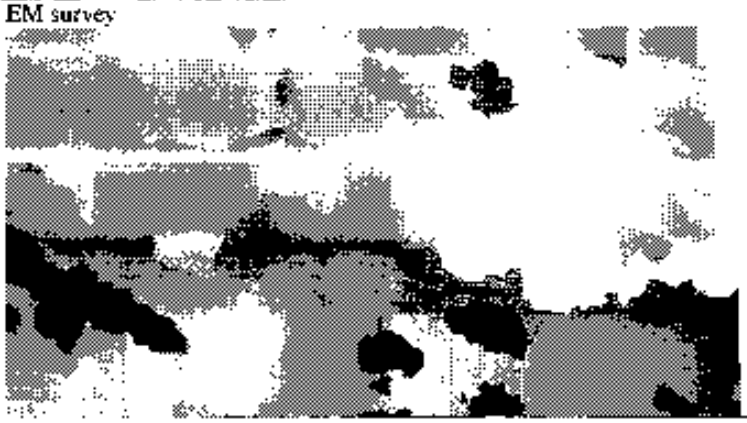
	52kg/ha
	72 kg/ha
	102 kg/ha

Urea rates. north / south
0 = no urea
80 = 80 kg/ha pre-drilled

Soil Map

Farmer drawn soil map

EM survey



Legend	EC (µs/m)
	0.83-1.31
	0.68-0.83
	0.53-0.68
	0.26-0.53

Yield map

Legend	T/ha
	3.5 - 4.0
	3.0 - 3.5
	2.5 - 3.0
	2.0 - 2.5
	1.5 - 2.0
	< 1.5

Yield, protein and screenings

In 24 blocks (representing two urea rates x 3 sowing rates x 4 replicates) running samples were taken at harvest and analysed for protein and screenings. Yields were determined for each block from the yield map (Table 2).

Table 2. Analysis of Protein, Screenings and Yield of Plots 1 to 24

	Yield t/ha			Protein %			Screenings %		
	Sowing rate kg/ha			Sowing rate kg/ha			Sowing rate kg/ha		
Nitrogen rate kg/ha	52	72	102	52	72	102	52	72	102
0	3.13	3.12	3.08	13.9	10.3	10.8	8.0	3.8	2.8
38	3.14	3.03	3.02	13.2	10.4	12.5	7.8	4.3	4.5
Significant Difference:									
N rate	NS			NS			NS		
Sow rate	NS			P<0.001 LSD=1.0			P<0.05 LSD=2.9		

INTERPRETATION

The EM38 survey conducted prior to sowing and the farmer drawn soil map identified changes in the soil in the same areas of the trial paddock. These areas matched up with the differences in yield. The EM survey explained 47% of the variation in yield across the paddock (regression equation: Yield = 5.24 4.2 x EM).

The heavy clay soil yielded the least (0.5 to 2t/ha) and the sandy or loamy soil yielded the highest (2 5t/ha to 4t/ha).

There were no effects of urea rate or sowing rate on yield. Sowing rate had a significant effect on protein and screenings. As sowing rates increased the level of screenings decreased.

It should be noted that plots 1 to 8, with a sowing rate of 52kg/ha, were located across some of the heavy soil type in the paddock. It could be that the heavy soil type, rather than the low sowing rate, could have influenced the screenings achieved in these plots. When these plots are removed from the analysis and plots 9 to 32 are compared then the effect of sowing rate on screenings is reduced.

PRACTICAL IMPLICATIONS

1. **High sowing rates and screenings**

The results of the paddock trial was similar to the results obtained over three years at a number of trial sites where sowing rates were investigated in relation to quality characteristics. High sowing rates did not guarantee low screening levels but it did contribute to low screenings.

2. **Interpreting yield variation**

The EM38 survey is an excellent tool for locating the changes in soil characteristics across a paddock, however it does not identify the different soil types. Farmer knowledge of changes in soil type is an essential ingredient when interpreting EM survey maps. Soil type variation has a large influence on yield and grain quality. In this example of paddock experimentation in the 2000 season there was a reasonably good relationship between the EM survey and grain yield (almost 50% of the variation in yield across the paddock was explained by the EM survey). The practical implication of how to manage this variation is not clear. It will be important to obtain a yield map over a number of seasons so the yield variation in different crops and seasons can be observed. A long term nutrient balance may then be used to better target fertiliser inputs.

The EM survey together with a good knowledge of soil type and historical yield variation across the paddock may also be able to be used to identify paddocks in which sowing a particular crops such as lentils may be an unacceptably high risk.

One large problem with interpreting yield maps is that results obtained on different soil types, is season dependent. In a different season a very different result can be obtained.

3. **Soil sampling and soil types**

Identifying changes in soil type and high and low yielding areas allows for strategic sampling. The decision can be made to test soil of different yielding areas separately. This may identify more accurately the reasons for low yields and changes in the management of these areas may improve yields.

4. **Location of research trials in paddocks**

Soil type has a very large influence on yield and grain quality and often overrides management factors. In addition, the outcome of a management practice on yield could differ between soil types. The EM survey is an excellent tool to ensure that the location of research trials is on as uniform a soil type as is possible. This will greatly reduce the inherent variation within treatments so often observed in small scale trial plots.

5. **Value of small scale research plots**

What do the results of small scale plots actually mean in terms of farm management across a paddock? The answer to this question has a lot to do with the type of management which is being investigated. In many cases the soil type variation across a paddock is so large that interpreting a result from small scale plots is difficult. The trial results observed in one location in a paddock on one soil type resulting from a management practice may not transfer to another location and soil type, especially if you consider the very large influence the season has on the final outcome. Small scale research plots aimed at management systems (for example sowing rates; fertiliser rates; variety performance; sowing times etc) are worthwhile for working out principles but are not robust enough to translate into changes in a paddock, let alone to make decisions on farm management. To use small scale research plots to work out economic outcomes on a paddock or farm basis is fraught with danger – the variability is much too large. The only way to overcome this problem is for researchers to work much closer with farmers so that the variability seen across paddocks and farms is observed and interpreted before costly large scale management practices are put into place.

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