Precision agriculture: Improving yields and reducing inputs

By Andrew Smart, Precision Cropping Technology

Precision agriculture (PA) now covers a number of techniques and products which have evolved due to the introduction of GPS. Many of these products have specific application which can give positive returns — the most basic example is removing overlap using guidance.

Beyond the simple is the more complex side of PA — understanding yield limiting factors on varying levels from farm to field to within field. Once this is achieved, knowledge will show you can be implemented to increase yields and combine with variable rate input application to reduce or improve input placement.

There are a number of influences which can cause variation in yield and this can be complicated by various levels of inter relationships between these factors.

Leading growers are determining the soil types they have and how best to manage them for the optimum field return. Through the management of the majority soil type, they try to control the outcome of the crop and therefore management of the spatial variation.

Variable rate nutrition is now being used pre-sowing based on soil type and knowledge of yield potential. During crop growth, remote sensing and EM information are used to manage crop growth with growth regulators, foliar fertilisers and improving the efficacy of defoliation.

Before we start seriously using variable rate application we must have some base levels of information. We need to know:

- Which zones have what yield potential (mostly effected by water);
- What the nutrient status is;
- What the crop requirements are; and,
- What levels are needed so they can be managed accordingly.

Better management of water and nutrients through the season may reduce or eliminate the need for in-crop reaction.

Once variable rate management is started, another variable is added to the system, so good qualitative information must be available from the start.

So what data layers can provide useful information?

1. Soil mapping: EM38/31

The use of EM information is becoming more widespread and better understood. EM38 is a conductivity measurement of the soil that is influenced mainly by salts, clay and moisture (ECa). In the absence of high salt concentrations and with a known uniform moisture profile, you can map very accurately soil type variation within a field.

Having this map provides information on where soil type boundaries change and the area of each soil type within a field. With strategic soil sampling you will then gain a clearer understanding of the soils — both chemically and structurally.

What is this information useful for?

- Placing moisture probes. The idea is to place the probe in the majority soil type so water use is managed for these areas of the field. In addition, it can determine the order of fields to be watered and the order of water sets within a field.
- Determining where to soil and leaf test for nutrients. If you're doing blanket field applications, this majority area is very important. If you manage the majority soil type in any given year you should be aiming at the highest possible result to optimise whole field performance. If you are doing variable rate application, all zones need to be tested separately.
- As a base map for the application of soil ameliorants. Soil test and EM results allow the building of variable rate gypsum, lime and manure application maps.
- Other soil information useful in these processes can be the original cut and fill maps and bare soil imagery.

2. Elevation data

Data collected from RTK steering systems provide excellent information and opportunity for extra return on investment from this technology. The derivatives of this RTK data are 'error from plane' (EFP) and 'slope' which are the most useful to irrigators. Error from plane shows where in the field water will shed or lay and bet-

26 ▷

The use of EM information is becoming widespread.

◁ 25…PRECISION OR INFORMATION?

ter decisions can be made on re-levelling fields or parts of fields, which reduces earthmoving costs and destruction of soil structure. Row slope is a supportive tool to understanding the influence of water on soil types — that is, within a soil type we can determine if it was over or under watered by its correlation with yield.

3. In-crop imagery

Early season imagery can be as captured as early as the two leaf stage for the examination of plant stand and early disease problems. Mid season imagery can be used to quantify the use of inputs during the season such as growth regulants and foliar fertilisers and over time can be used as a predictive tool.

It's possible to look at imagery during the season and compare it to previous years' imagery and yield maps to give indications of what may be the outcome in similar seasons. Late season imagery is typically used for management of last watering, defoliation and yield estimates.

4. Yield

Yield data is the piece of the puzzle that allows quantifiable analysis and makes the above information into decision making tools based on numbers. With a large number of yield monitors now being used, good quality yield data for analysis is now possible. Some of the basic derivatives of yield include gross margin and nutrient usage and replacement maps.

5. Water application and balance

The work being carried out using the Irrimate services and sensors fits well into the PA arena. The improvements in water application these systems provide are enhanced through spatial knowledge offered by PA.

For example, if you're trying to manage water for the majority soil type within a field, you can locate these tests more precisely so the information is relative to the soil type you are planning to manage. On top of that, the yield loss or gain under different systems can be tested more accurately in terms of bales per megalitre.

OUTCOMES THROUGH ANALYSIS

Following are some examples of case studies and work that has been carried out by Precision Cropping Technology.

- Variable rate gypsum — savings of as much as $120 per hectare have been demonstrated as well as improved placement — that is, higher rates are used where required.
- Prioritised levelling — savings because only 25–75 per cent of fields were re levelled rather than whole fields.
- Locating moisture probes at the ideal monitoring sites for a field (see Figures 1 to 3).
- Variable rate growth regulators — provides more crop management advantages than instant financial improvement.
- Variable rate defoliation — there were savings during the 2005 pick of $15 per hectare with improved picking timing.
- Soil zone management strategies have shown yield gains can be made of 0.5 to one bale per hectare.
- Variable rate nitrogen in dryland wheat — savings have been $15–20 per hectare.

TRIALS

Precision agriculture implementation must pay for itself a number of times over to be worthwhile. Some products are easily justified such as in the case of an improved re-levelling program. Some provide better management practices — like the placement of moisture probes and soil test site selection. But others need to be tested further.

For instance, trials are required to determine the results from variable rate fertiliser, gypsum, growth regulators, plant populations and defoliation — to determine whether the results provide financial or management benefits, or both. Trials are more easily planned and measured than changes in practise.

For more information regarding these and other results contact Andrew Smart at PCT on 0267922638 or 0428922638 or drop into site 167 at the Australian Cotton Trade Show in

FIGURE 1: EM38 survey, majority soil type

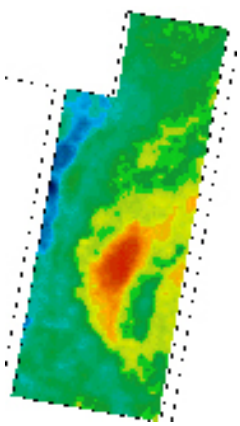

FIGURE 2: EFP plus areas close to grade

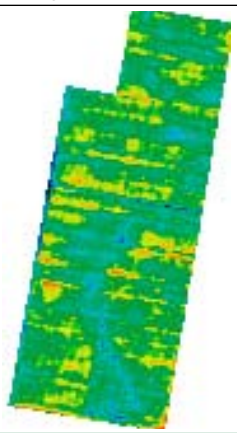

FIGURE 3: Probe map (map of ideal monitoring sites)