

GETTING INTO PRECISION AGRICULTURE

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Soils vary across farms and within paddocks but the practice has been to manage these as though variations did not exist – applying a consistent rate of fertiliser across a paddock being an example.

This method of management is being questioned as farmers strive to cut costs and improve production efficiencies. They are keen to find out where the high and low yielding areas are, and the causes of the variations. Sometimes it is possible and practical to treat low yielding areas and make them more productive. If it is not then why waste inputs such as seed, fertiliser or chemicals, for little or no gain? Hence the interest in Precision Agriculture (PA) which is developing because as farm size grows, farm managers need tools that enable them to capture more information at low expense and so effectively manage large areas with a high degree of local area knowledge.

Why change?

Targeting inputs – A major aim of PA is to increase farm production and profits relative to the inputs used, and their related costs. The consequence of this is the application of fewer inputs to lower yielding areas, and more inputs to higher yielding areas.

Environmental benefits – One of the significant benefits of more targeted application of crop production inputs is that there will be less chance of wastage, overlap or underlap in spraying applications and, potentially, less off-site leakage of chemicals/nutrients.

Disease management – PA can be an effective tool in the management of crop disease as through mapping, areas of lower growth and grain production can be identified and mapped and soil-borne diseases identified through soil sampling. Aerial or satellite imagery can also be 'real-time' aids in the detection of disease.

Equipment needed

Those engaging fully in PA have yield monitors in their harvesters connected to a GPS system; this data being transferred to a home/office computer where maps showing paddock variations are produced. Images on the map are compared with those produced from an Electro Magnetic (EM) survey of the paddock which shows variations in soil characteristics.

Yield maps are produced over a number of years to document any yearly variations. Soil tests are carried out to find out the cause of variations – it may be soil-borne diseases which are causing the problem and these can generally be remedied, or it may be toxic subsoil substances, or other subsoil constraints, which are more difficult, or sometimes impractical, to overcome. Machinery using variable rate technology, a seeder or fertiliser spreader for example, can then be used to apply differential rates of inputs to the paddock. This is achieved via a computerised map of various paddock zones being programmed into a control module with GPS positioning, then this is linked to the equipment's variable rate controller. This step is often hampered by compatibility issues, so careful planning before purchase is required.

Yield monitors – these are supplied by most major harvester manufacturers as either a standard fitment or an Original Equipment Manufacturers' (OEM) option, and also as an after-sale fitment. Output formats of many of these systems are different and data often needs post-harvest processing to correct anomalies.

GPS - farmers can utilise the basic GPS satellite signal from any handheld unit and can gain improved accuracy by using either a free marine navigation signal which is limited to a range of 450-500 km, a commercial satellite correction signal for an annual fee, or in addition to a satellite system, using a user-owned ground-station beacon. Generally the more accurate the correction the more expensive the purchase and annual costs will be.

In many situations however, farmers can begin yield mapping with a simple navigation beacon correction signal combined with the basic satellite GPS signal with no ongoing annual fees.

Home computer – Most late model home computers can be used for PA although considerable RAM memory is required. Careful selection of software that enables yield data to be accessed from the yield monitor, assessed, and then processed is needed.

Maps – The Southern Precision Agriculture Association (SPAA) suggests that a standard colour legend be used in paddocks with red colour showing the lowest yielding areas, through to blue being the best.

A basic map can be compiled with many software packages, however it is suggested that the raw data is processed and cleaned up with professional assistance before going further with the use of this data.

Variable Rate (VR) equipment – While VR technology, largely involving seeders and sprayers, is still developing many farmers have been able to use the technology in a cost-effective way to reduce inputs on areas that are clearly unprofitable. Sprayer guidance systems have also been able to produce significant cost savings through reduced overlap/underlap.

Crop imagery – images of crops can be taken from satellites or aircraft and show differences in crop growth. Currently SPAA is trialing this technology which will become a useful aid in PA.

Summary – Careful selection of the most appropriate equipment is required. It is best to start with basic yield mapping and guidance systems on sprayers.

Associated issues

Complexities – PA is not ideally suited to those farmers and their employees who do not like using computer-based technologies. Farmers interested in PA are advised to undertake training before they commit a significant amount of financial resources to it. Training can also identify the level of PA technology the business requires and what the 'real' hardware requirements will be. Specialist PA technical support and data interpretation support is essential.

Machinery and equipment - Most of the major harvester manufacturers provide an OEM yield monitor as standard on current models. Generally all that is required is a GPS location signal to enable yield mapping to begin. This may cost as little as \$1,000, but some additional computer hardware may need to be purchased from the manufacturer to enable data to be captured onto a data card which is then fed into a computer to produce the yield maps.

Many current model airseeders are 'VR ready' in that they can take a signal from an OEM or after-market manufacturer to control the seed and fertiliser metering mechanisms. Buyers need to be aware that issues with data, software and hardware compatibilities can arise when mixing brands of equipment.

Incompatibility issues – There are many data and communication standards currently used in the marketplace and this has caused equipment compatibility problems. However, recent improvements in mapping programs and VR software are occurring and will enable a wider range of data formats to be imported and exported. The ability of many hardware systems to 'speak' to each other is often limited between brands of hardware. PA systems that utilise software-based solutions will be more 'future proof' as software upgrades become available with wider compatibility.

Preparation

All the farm at once? – For yield mapping and spray guidance systems, it is feasible to use the technology across the entire farm to maximise the financial benefits once the equipment is set up. However, when it comes to using VR and crop imagery technology, farmers can focus on a particular area to increase their understanding of the VR application. Some limited VR trials may be required to achieve this.

EM 38 survey – this is a useful way of identifying paddock management zones in combination with yield maps and other available data. EM 38 surveys are carried out by agribusiness on contract using specialised equipment. With targeted soil sampling, EM 38 survey results are useful in correlating soil physical and chemical properties highly related to crop productivity.

Soil tests – Selected soil testing of defined areas determined from yield maps, EM 38 surveys, and airborne or satellite imagery, is a cost-effective way of determining factors, including soil diseases, which may be limiting grain yield and grain quality.

Interpreting results – Professional PA assistance, particularly when correlating information from yield maps along with that from EM 38 surveys, aerial and satellite imagery and associated soils tests, is often needed. Experience in statistical analysis is required to determine the significance of the data correlation. In the generation of yield maps, data must first be checked for anomalies.

GPS guidance for controlled traffic

There are many benefits of controlled traffic farming:

- **Reduced costs.** Considerable savings occur with fuel, seed, chemical and fertiliser. Reduced overlapping can reduce fertiliser, seed and spray applications by 4%. Where wide row spacing crops are sown (beans and summer crops), inter-row spraying can reduce chemical applications by 66%.
- **Reduced draft requirements.** Smaller tractors are being used, as less power is required to pull the same machine at sowing. In heavy clays, power requirements can be reduced by as much as 50% with normal seeding moisture. This results in significant reductions in fuel use. It is feasible on a 250 hp tractor to have a reduction in power requirement of up to 50 hp in controlled traffic compared to a conventional system.
- **More timely operations.** Herbicide and fertiliser applications can occur at more appropriate times due to increased traffic ability in wet conditions. Crucial operations such as fungicide application to coincide with rainfall events can take place sooner, reducing disease levels. Post seeding fertiliser applications can occur during wet periods, increasing the efficiency of these applications.
- **Reduced fertiliser and herbicide application costs.** Applications can be made with farmer equipment rather than relying on contract operators. Better weed and disease control is likely with higher water rates being used with ground application units. Less over and underdosing results in less crop damage and fewer weed escapes.
- **Better placement of seed and fertiliser.** Plant emergence is more even and uniform and combined with more accurate fertiliser placement results in increased plant nutrition and better plant growth.
- **More accurate sowing systems allow for more accurate herbicide and fertiliser placement.** Between row weed control is already practiced in wide row spacing summer crops. A combination of between row covered spray units and guidance equipment may allow the use of non-selective herbicides for weed control in winter crops. This will delay the development of herbicide resistance to selective herbicides. Side dressings of fertiliser may also be possible – placing post crop emergence fertiliser alongside plant roots and not in the inter-row where they will stimulate weed growth.

What sort of GPS do I need for controlled traffic?

- Sub metre accuracy ie marine navigation beacon, or basic sub metre satellite differential GPS is not accurate enough for controlled traffic, although it will improve pass to pass spraying accuracy.

- Ideally a sub 10-20 cm accuracy system is required as a starting point for controlled traffic. Marker arms and permanent wheel tracks are a good substitute for this level of accuracy
- For inter-row seeding, spraying or fertiliser placement a sub 2cm accuracy auto-steer system is required with an RTK base station system.

CANBus ISO 11783 - An emerging standard in PA and agricultural machinery

There continue to be major advances in precision agriculture technologies. With an increasing range of tractor electronics such as auto-steer systems, sprayer, seeder and implement controllers, farmers are increasingly becoming confused, particularly when it comes to product compatibility

The upcoming standard in the agricultural area for communications between a tractor and an implement is called CANBus ISO 11783 which is sometimes referred to as the generic CANBus or more specific Isobus in short. This standard forms the backbone of the autonomous agricultural machine system. CANBus (Controller Area Network, plus a Bus or data path shared by many devices) was originally developed in Germany by Bosch primarily for use in automotive applications. There have been many different standards of CANBus developed since the 1980's, some are used universally and some are proprietary.

The international CANBus ISO 11783 standard, sometimes call ISOBus, has been widely accepted for agricultural applications. The standard consists of twelve documents ranging from definition of the transmission medium to application of the entire spectrum of serial communications based on CAN.

Why do we need CANBus ISO Standards

Many farmers currently run a mixed tractor fleet and require standardisation for ease of transferability of equipment and reduced hardware costs. Standardisation will improve cab ergonomics; reduce connector and cable clutter, reducing terminals damage. It will also simplify support and training for these devices.

Why was ISO 11783 developed?

ISO 11783 was developed to standardise the method and format of transfer of data between sensor, actuators, control elements, information storage and display units whether mounted or part of the tractor, or any implements. This will provide an open system such that electronic systems produced by different manufacturers can happily communicate with each other.

What does all this mean for farmers?

In summary it appears that the ISO 11783 standard will emerge as the dominant standard for agricultural electronic control systems and precision agriculture. Equipment purchased without this connectivity standard will have an accelerated rate of obsolescence.

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