Heard and Seen at the 11th ECPA

The 11th European Conference on Precision Agriculture took place in Edinburgh, 16-20 July 2017. It has been 20 years since the first ECPA conference organized in 1997, at Warwick University, UK, covering the main aspects of Precision Agriculture at that moment: spatial variability in soil and crop, information technology and crop management. The ECPA 2017 continued the successful format of previous conferences building strong links between the industry and the academia. The theme of the conference, 'Innovating through Research', enabled all involved in Precision Agriculture (PA) to participate. The papers represented a wide variety of Precision Agriculture applications from the traditional areas such as nitrogen sensing and crop sensor development to more emerging areas such as data analytics, information systems and UAV applications. Reflecting the conference's location in a northern European city, where grass is a dominant production system, the ECPA 2017 included a satellite meeting dedicated to Precision Management of Grassland & Grazing Livestock. Prof Martinez-Casasnovas and the Univ of Lleida Team have the story for New Ag International.

TAKE HOME LESSONS AFTER TWENTY YEARS OF PRECISION AG

A special plenary session about 20 years of Precision Agriculture was delivered by different keynote speakers with different perspective; They exposed a precise review from the beginnings of Precision Agriculture, in the late 1990s, to the present.

Dr. K. Sudduth (USDA) presented the initial development of precision farming based on yield maps, which have been subsequently complemented with on-the-go mapping of soil apparent electrical conductivity. Nevertheless, the early beginnings of PA were in the 1920s in the USA, with the creation of a soil pH variability map by the University of Illinois based on a grid soil sampling approach. He also showed how research has grown in the last decades, not only in big countries such as USA or Australia, but also in Europe, with Spain as the second country in number of peer-reviewed articles in the journal Precision Agriculture (Springer) at present.

From the industry point of view, M. Moore (AGCO) highlighted that one of the main challenges is integration. This applies to the collaboration among all agents involved in PA (application developers, academy and research institutes, industry and farmers); and, from the industry point of view, integration also of technology. Supply chains can be long and complex, making the delivery to the farmer complex. From the farmer point of view, the technology is often fragmented, leaving the farmer to be the systems integrator while local support is often lacking. "The future that we can expect is not a research farm, nor a commercial farm, it's something that is in the middle". It is needed that developers of technology, service companies and agronomist go to the farm and see how all can learn together. Industry has to promote collaboration across different sectors to deliver supportable turn-key systems to farmers. "This is the future farm: sit together and cooperate". Mr. Moore claimed that plug and play solutions already exists but the integration of local knowledge and agronomic knowledge with technology to ensure the value proposition is obtainable at farm level is still pending. "The future farm is addressing the challenges experienced over the last 20 years. Technology is not the problem, the problem is delivering technology to the farmer in the way that the farmer stops becoming the systems integrator".

FARMERS VIEWPOINT: EASY TO USE AND CHEAPER TECHNOLOGY MAIN DRIVERS OF GROWTH

The farmer's point of view was given by N. August (The Douglas Bomford Trust & August Farms). He presents himself as passionate about the land, being part of the growing number of farmers to embrace conservation agriculture and Precision Agriculture on his farm in Oxfordshire (UK) for the past 20 years. He started with yield mapping. "It is the baseline by which all variable inputs are judged". Later, he recognized that soil is where nearly all crop variability starts and began working on nutrient grid soil sampling to detect deficiencies to be addressed. Then, in the last years he experimented with the Veris sensing technology to map soil apparent electrical conductivity. "It was the last operation adopted but it should be the first, since it is an easy and fast way to map the probable variability of soil properties within the fields". In addition, other practices such as controlled traffic farming (CTF) and precision nitrogen management were incorporated in his PA baseline. From the point of view of this precision farmer, the challenges for full PA adoption are: better connectivity of different technologies, backward compatibility not constrained to a single manufacturer, simple to use technology for less money, better self-diagnosis, more training (farmers, operators and technicians) and programmers to be more familiar with the products and the users they are developing the applications for.

Dr. Ian Yule from the New Zealand Centre for Precision Agriculture, Massey University and President Elect of the International Society of Precision Agriculture (ISPA) delivered the keynote of the satellite meeting on Precision Management of Grassland & Grazing Livestock. He emphasized that the new digital agriculture is connecting farmers and agronomist, food manufacturers, environmentalist and policy makers. "We need to understand the purpose and value of each application, e.g. understanding agricultural science as well as technology; we need to research and develop affordable technology, driving costs down".

The 11th ECPA 2017 showed that Precision Agriculture is a new paradigm in operation and is forming part of the day to day farm activities. Nevertheless, there are still big challenges to face: education and/or training on PA operation, integration of technology, development of standards, cooperation of all involved agents, automation of decision making and reduction of costs (among others). We will have a new opportunity to know any advance in those challenges at the 12th ECPA (July 2019) to be held in Montpellier (France), organized by Dr. Bruno Tisseyre and his group at Montpellier SupAgro/IRSTEA. ■

Sensing in Precision Ag: What sensors tell about the crop environment

Our great-grandparents and their ancestors did not use any sensor but knew their fields perfectly. The reason is that they had their feet on the ground, literally. They had to walk throughout their fields either sowing, weeding or ploughing with mules. And they had time to know which areas in their fields were better than others. With the appearance of the tractor and agricultural mechanization in general, things started to go faster and fields started getting bigger, so much so, that sensors are now required to provide farmers with the information they once had. In this 4th Precision Ag Corner issue we will discover how different sensing systems can help farmers gather information on the surroundings of their crops. In the next issue of the magazine, we will cover the techniques allowing to sense the crops properties themselves. Jaume Arnó, José A. Martínez-Casasnovas and Alexandre Escolà, of the University of Lleida-Agrotecnio Center in Catalonia, Spain have the story for our readers.

In the first Precision Ag corner we introduced the cycle of Precision Agriculture and in the second we described the global navigation satellite systems (GNSS). The first stage of the PA cycle is Data Acquisition. At this stage, the aim is to detect spatial and/or temporal variability by means of visual scouting or using sensors. Data will be subsequently analysed to be turned into information (2nd stage) to make informed management decisions (3rd stage) to be implemented in the field (4th stage). This issue reviews general aspects of sensing techniques and some of the most usual sensors and sensing techniques in Precision Agriculture to be used together with GNSS to obtain georeferenced soil data.

A NUMBER OF SENSING TECHNIQUES

Regarding the distance between the sensor and the target, sensing techniques can be classified as proximal or remote sensing. Technically, a remote measurement is any measurement obtained without contact with the element being measured. That would lead us to consider nearly all techniques used in PA as remote sensing. However, it is commonly accepted in PA that proximal sensing techniques are those used for ground-based measurements. Therefore, any measurement obtained from drones, aircrafts or satellites is to be considered remote sensing. Table 1 show the pros and cons of both sensing techniques.

As far as the spatial resolution of the measurements is concerned, some proximal sensing systems (sensor and data loggers) are only able to take single site measurements. The reason may be either the sensor needs a special setup or it needs to be manually triggered. Other sensors are able to obtain continuous measurements over time without special sensing requirements so they only need to be moved throughout the fields while recording its output signal and the coordinates of a GNSS receiver to georeference the measurements. The latter are usually called on-the-go sensing techniques.

When sensors are to be stationary in the field, e.g. buried soil moisture sensors, or sensors attached to fruits, they can provide farmers with high temporal resolution data. The spatial resolution, though, is usually very low since it directly depends on the number of sensors deployed in the field. Frequently, there are only one or few sensors per hectare and that makes sensor location a very important issue to be considered in advance. These kind of sensors are usually connected by wireless communications in what is called wireless sensor networks (WSN).

Alternatively, on-the-go sensing systems may provide farmers with very high spatial resolution data. In those cases, the temporal resolution will depend on the times the system is taken to the field, commonly resulting in low temporal resolution data series. Finally, hand operated sensors will generally provide with low spatio-temporal resolution data.

Table 1. Pros and cons of proximal and remote sensing techniques

PROXIMAL SENSING	REMOTE SENSING
+ Usually very high spatial resolution + Simpler technologies + Possibility of using multiple sensors at a time + On-the-go derived operation capabilities	+ No contact with the crop or soil + Large scale measurements (field, farm or region) + Instantaneous (single-shot) measurements keeping environmental conditions all the same
- Need to step on the field - Small scale measurements - Longer acquisition times (resulting in different environmental conditions)	- Usually lower spatial resolution - Usually more expensive techniques - More meteorology dependent - Need for atmospheric corrections when using satellites

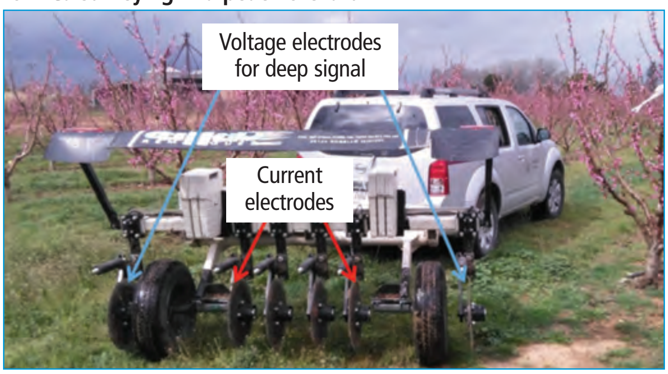
Regarding the type of measurement, sensors can directly measure properties or parameters of the crop and its environment or estimate them indirectly. According to the former, some sensors can measure canopy height and width or even grain production, for instance. Indirect sensing techniques need to previously establish correlations between simple observations and complex estimations. Such is the case of remote sensing techniques, where light reflectance in different spectral bands is used to calculate radiometric indices which are correlated with physiological phenomena in the crop.

SENSING OF SOIL PROPERTIES: ELECTRICAL CONDUCTIVITY A KEY TO UNDERSTAND WHAT'S GOING ON IN A FIELD!

Crop production and growth are undoubtedly affected by the soil where the plants are rooted given the plant-soil interaction. But the most interesting is the non-homogeneity of the soil that can occur in many plots, with a composition and physical and chemical properties that may vary spatially and in depth. These variations can be found at different spatial scales. The result is often a variable harvest depending on the location and, as many well-known researchers say, the knowledge of these spatial patterns could help farmers make better management decisions based on the delimitation within the plots of different areas with different soil conditions and agronomic needs.

Soil sensors for mapping the apparent soil electrical conductivity (ECa, in mS/m) are increasingly used to understand and evaluate how soil varies spatially to delineate ECa-based management zones. Some interesting applications can be referenced in arable crops and, at present, it begins to be applied as a key sensing system in the framework of precision horticulture and viticulture. ECa varies on a similar spatial scale to many soil physico-chemical properties, and is usually well correlated with soil salinity, soil water content and soil texture. Other soil properties affecting conductivity may be the organic C, the cation exchange capacity and the calcium carbonate content. Under non-saline conditions, soil texture (more specifically clay content and low concentrations of dissolved electrolytes) and soil water content are probably the two predominant factors influencing ECa. Therefore, obtaining a map of the ECa is a way to indirectly evaluate the variation of soil properties within the plots. Two soil sensing systems are commonly used to measure the ECa, that is, the ease with which electric current passes through the soil. On-the-go sensors based on galvanic contact with the soil (Fig. 1) directly introduce an electric current into the soil by means of adequate rolling coulters acting as electrodes. The current flow occurs between a pair of rolling coulters normally located on the inner part of the implement wheels (injecting electrodes). Other pairs of coulters (two in some cases) act as voltage electrodes providing two electrical signals corresponding to two different depths. The central rolling coulters supply the so-called shallow signal corresponding to the topsoil. The second signal (deep signal) is achieved with the rolling coulters located outside the wheels because, as they are farther apart, the soil electric field allows for a greater depth to be explored.

Figure 1: Veris 3100 on-the-go soil sensor for ECa surveying in a peach orchard



Farmers and advisors can benefit from this information by obtaining maps of both signals (shallow and deep) to evaluate the ECa spatial variation, and, indirectly, the spatial patterns of related soil properties. Moreover, by overlapping maps they can also assess whether the soil is uniform or not in depth for a better management of irrigation and/or fertilizer application.

Alternatively to galvanic contact resistivity (GCR) sensors, ECa can also be measured using methods based on electromagnetic induction (EMI). In this case, EMI sensors introduce into the soil a primary magnetic field and the electric current is created by moving the system just above the ground, with any contact with the soil. This induced electric current in turn creates a secondary magnetic field whose intensity is detected by the sensor and depends on the properties of the soil. Among the GCR sensors, the Veris 3100 (Veris Technologies Inc., Salina KS, USA) (Fig. 1) and the ARP03 system (Geocarta Ltd., France) (Fig. 2) are well known in Precision

Figure 2: Galvanic coupled resistivity ARP03 sensor by Geocarta (left), and electromagnetic induction EM38-DD sensor by Geonics (right) with horizontal and vertical orientation (courtesy of Gebbers, 2016)

Interview with Dr. Raj Khosla, Colorado State University

Prof. Raj Khosla is a Robert E. Gardner Professor of Precision Agriculture at the Colorado State University. He is the Founder and Past-President of the International Society of Precision Agriculture.

You are one of the most influential researchers in Precision Agriculture and you have followed its evolution since the very beginning. What has been the evolution and the lessons learned in crop and soil sensing since you started?

Yes. Precision Ag has come a long way since its inception. I would say in the last couple of decades since precision ag has been around, initially a huge amount of time, money and resources were spent on quantifying spatial variability primarily in soils and then later on in crops as well. In the last decade, there is a whole suite of sensors that became commercially available, and we have made significant progress in terms of characterizing soils using soil electrical conductivity, likewise characterizing variability in crop canopy using a suite of reflectance-based crop sensors. However, I think that we still have a long way to go. Let me elaborate. For example, if you look at any reflectance sensor and the associated vegetative index, it primarily gives you a flavor of biotic or abiotic stress, it doesn't really tell you which particular stress or the cause of that stress. For example, we use NDVI, a lot of times we use that to make nitrogen decisions, when, in reality NDVI only tells you that there is an anomaly, which we intelligently assume (using algorithms) that it is related to nitrogen but we don't necessarily know that nitrogen deficiency is really the cause, because it could be iron chlorosis, it could be insect, pest infestation that made the plant look pale or many other factors that could result in a low NDVI value. So I think what we have in place right now in terms of sensing, I would classify that as the 1st generation sensors. As we go forward, hopefully we'll have sensors that would enable accurate classification of the problem that we detect in the fields.

In the last few years many crop vigour sensors and sensing techniques have appeared in the market but there seems not to be an accepted standard in vegetation indices, spectral bands, methodology, etc. How do you think this is affecting the application of Precision Agriculture solutions, the inter-season comparison and the decision making?

I think you bring up a very good point. The reason that farmers are reacting slow to adopt these new ways of sensor based recommendations is because, as I mentioned earlier, we don't precisely know what is causing the plant stress. Is it truly driven by nitrogen deficiency or there's a whole suite of crop response that can be captured by vegetative indices currently available to farmers. I would say, NDVI has been one of the most widely used vegetative index. More recently, as research dollars are being invested into this space, we are developing newer indices such as red edge based vegetative indices that are providing us with a better spectral response to aberrations. And so, until we have the sensing capability that can accurately inform us about the prevailing deficiencies in crop, we're going to tweak and try and continue to learn this process until we get there.

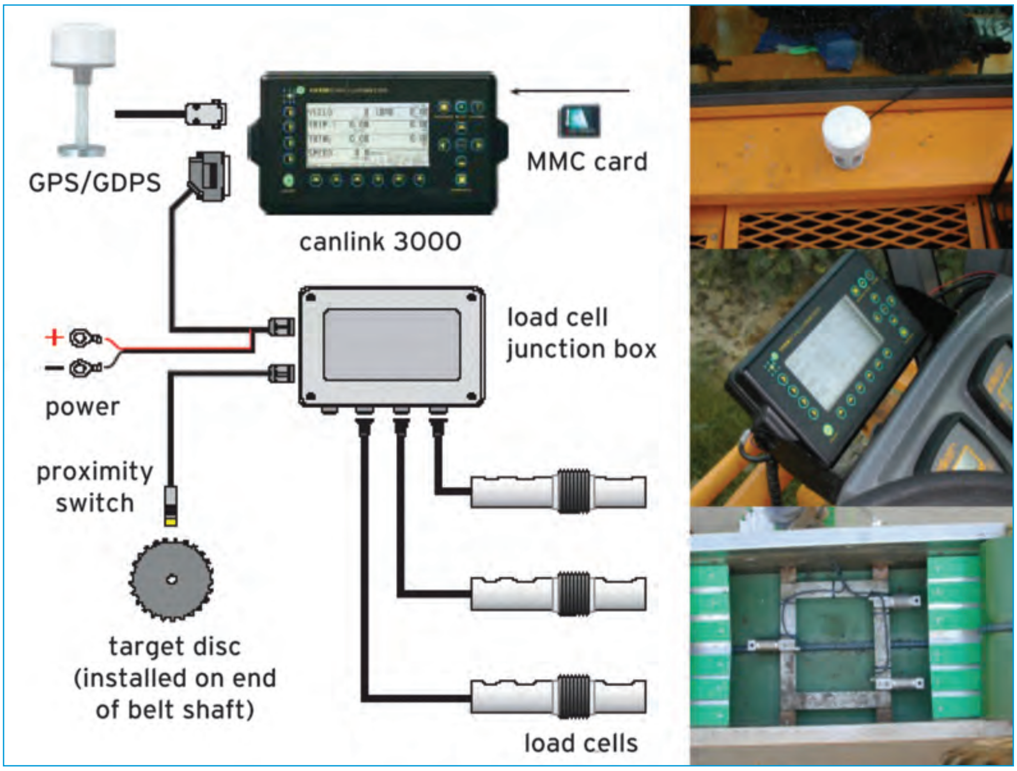
In many devices, such as soil sensors, the sensor output may give an idea of the signal spatial variability. However, the sensor signal is usually related to many soil properties and a single/simple diagnosis cannot be derived. Do you think this is still useful?

You're exactly right. The sensor signal is a culmination of a number of properties that are captured collectively in the sensor response. And one may argue that it has limited value because it does not pinpoint the exact cause. Having said that, one of the abilities of existing sensors is the ability to map large swaths of land in relatively short period of time without having to take very many destructive soil samples, without necessarily spending too much money, labour and time. And so what it does, it allows you to capture patterns of spatial variability out in the field. And I think there is tremendous value in knowing where the changes are in the soil because one can then go out in the field and can do some ground truthing in figuring out what is the cause that you see a change as you go from one part of the field to the next part. So yes, there is value in the current sensing systems.

How do you think sensing techniques will evolve in the coming years? What will make farmers around the world use them?

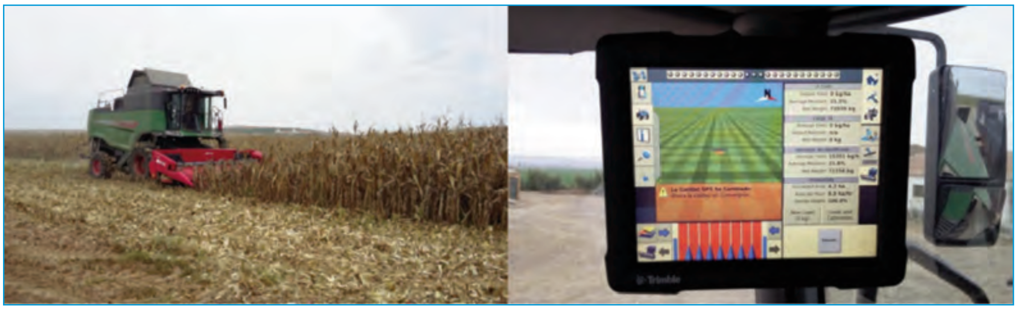
You are asking me a two pronged question. One related to research, the other related to adoption of a particular technique or technology by farmers. Precision agriculture is only about 20-25 years old but agriculture is more than 1,000 years old so we need to keep that in mind. I know we are using information technologies these days to help advance our agriculture, and such IT technologies advance quickly. But I think we need to put some realistic expectation in terms of what these new technologies can do for us. Until we are trying to figure out and improve our existing understanding of soils and crops based on what is commercially available in the sensing world, and develop scientifically proven and reproducible techniques and technologies, I think it would be unfair for us to expect that farmers are going to abandon their generations of time tested way of doing agriculture and jump on board and say we are now going to use sensing based agricultural decisions. I think it's an issue where we are building something and trying to use it at the same time. So there will be a learning curve, there will be growing pains. Slowly and surely we are making progress, and farmers are picking and choosing aspects of sensing, aspects of precision agriculture that currently fit into their operations. I think this will be a long journey before we actually get there, and I think we will!

Figure 3: Components of the Farmscan acquisition and monitoring system for vineyard (left). GPS/DGPS receiver antenna (top right), Canlink 3000 yield monitor (centre right) and load cells located under the harvester conveyor belt (bottom right).



Agriculture. In terms of EMI sensors, the EM 38-DD (Geonics Ltd, Mississanga, Ontario, Canada) (Fig. 2) and Dualem sensors (Ontario, Canada) are two of the most renown products. It is not easy to choose between GRC and EMI. Probably, the calibration is more complicated in inductive sensors. By contrast, resistive sensors require adequate contact between the coulters and the soil, and this cannot always be achieved if the soil is dry or stony. The suitability of soil sensors in agriculture has been recognized by farmers, technicians and a good number of researchers. It is not only a good technology for mapping ECa together with a georeferencing system, but also makes it possible to estimate the spatial variation of soil properties as soil texture, water retention capacity, organic material content, salinity and soil depth. In addition to allowing for the delineation of potential management zones, ECa maps are a useful tool for conducting soil sampling and then be able to determine the main causes that affect yield and/or harvest quality. On the other hand, it must be said that soil sensing is not only focused on ECa measurement on a volume basis. Other technologies are being developed with relative success. We refer to the measure of organic matter or water content by optical reflectance.

Figure 4: Combine harvester (left) equipped with a yield monitor (right) for the site-specific acquisition of corn yield.



SITE-SPECIFIC RECORDING OF YIELDS: THE 'CORNERSTONE' OF PRECISION AGRICULTURE

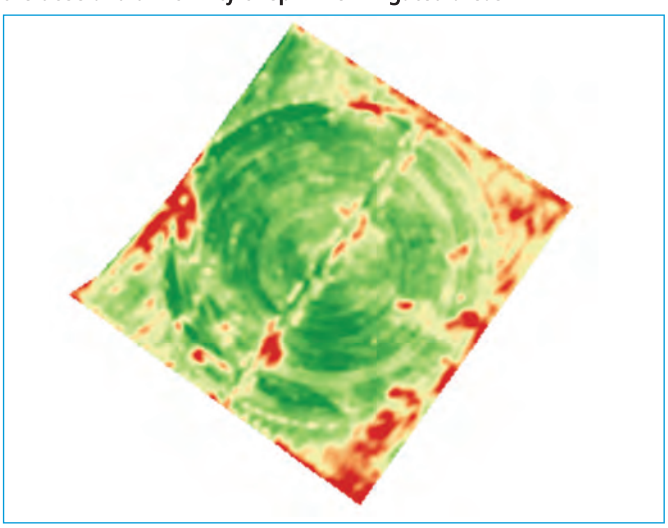
Yield monitoring is a critical phase when implementing a Precision Agriculture programme. Recently, at the European Conference on Precision Agriculture held in Edinburgh (ECPA'17), it has been emphasized again that yield maps are fundamental and cannot be replaced by other information when interpreting spatial variability and the effects of site-specific management on yields. In any case, yield maps in conjunction with soil analysis, remotely sensed variables, physiological and chemical analysis of vines, and other data, can elucidate why particular vines produce less fruit than others, as it was manifested at that Conference by E&J Gallo, an important winery in the USA. The first grape yield monitors became commercially available in Australia in 1999. An example is shown in Figure 3, which corresponds to the system initially marketed by the Australian company Farmscan (Bentley, WA, Australia). As it can be seen, the design is very simple and is based on a set of load cells that are installed under downloading conveyor belt of the grape harvester. By measuring grape weight and other required parameters (such as the distance travelled by the harvester and the spacing between rows), the monitor allows for calculating the yield in tons per hectare and georeferencing this data using a global navigation satellite system (GNSS).

The use of grape yield monitors also presents certain difficulties, usually linked to logistics and organizational aspects during harvesting on large farms. Following the example of the vineyard and, as mentioned in an ECPA'17 communication, plots larger than 5-10 hectares have to be harvested by more than one machine at a time in order to deliver grapes to the winery in a timely manner. Then, the number of machines used simultaneously requires an efficient method of handling the acquired data. In short, mapping large blocks harvested with multiple machines implies that yield monitors must be properly calibrated to avoid erroneous or missing data.

When it comes to cereal crops, yield maps are produced from data obtained by combine harvesters. Once separated from the straw, it is time for the amount of grain to be quantified on its way to the grain bin. Several volumetric or mass flow measuring systems are used in harvesters depending on the manufacturer. The most usual sensors for this purpose are impact plates and light barriers. The former estimate the grain mass flow rate from the impact of the grain against a calibrated plate. The latter use photoelectric sensors to detect the amount of light intercepted by the grain and correlate it with the volumetric flow rate. In this case (optical sensor), the system is supplemented with tilt sensors to achieve a correct measurement even when harvesting on slopes. As the measuring system is based on the volume flow principle, data are converted into mass flow by accounting for the grain density. In combine harvesters, as in grape harvesters, the principle of site-specific yield recording is simple, and basically consists of dividing the sensor grain output (t/h) by the corresponding harvested area (ha/h) that is determined from the speed and the working width. Sensor readings are recorded synchronously with GNSS coordinates to be subsequently processed to obtain yield maps (Fig. 4). To this purpose, raw yield data still need to be pre-processed (filtering, correcting, completing, homogenizing, etc.) and interpolated by means of geostatistical methods to finally obtain the yield map (Fig. 5) with normally good accuracy around 3.5-4%. Additionally, on-the-go grain quality measurements are also commercially available in combines, such as moisture content and, more recently, grain protein content. They are usually based on NIRS (near infrared spectroscopy) techniques. In addition to obtaining yield and quality maps, the added advantage for the farmer is the possibility of knowing the site-specific extraction of N and defining, for example, a prescription map for variable fertilization from the N uptake.

The proper use and calibration of these monitoring systems is crucial. Farmers and harvester operators should be aware that data may contain errors from various sources: positioning (GNSS), calibration, undetected changes in working width, etc. Additionally, before harvesting, they should check that the time the harvested grains take from the cutter bar to pass in front of the sensor (time lag) has been correctly adjusted.

Figure 5: Yield map of a corn field with a centre pivot irrigation system. The lowest yields (pale and reddish areas) are observed in areas outside the pivot, in the sprinkler irrigated corners. Apart from some possible soil problems, the farmer should investigate the dose and uniformity of sprinkler irrigated areas.



Air Scan: Soil testing from the sky

"The technology, if proven, will be a game changer for hill country farming"

MICHAEL WHITE

The use of fertilisers can have environmental impacts where nutrients are in excess of plant requirements and become susceptible to leaching into ground and/or surface water. Conversely, insufficient fertiliser applied to replace the nutrients removed as a consequence of production can also lead to adverse environmental outcomes such as overgrazing and erosion. Using technology to determine the correct amount required is key. The Ravensdown cooperative in New Zealand exists to help its farmer shareholders improve their productivity, profitability and reduce their environmental footprint. So Ravensdown looked around the world for technologies that would assist with better measurement of soil fertility in hill country to enable more precise and efficient applications of fertilizer to pastures.

As with most countries there are a range of soils within New Zealand, and the fertility of these is seldom uniform. Even within a single paddock, significant differences in fertility occur. On a hill country farm, the undulating nature of the topography and differences in microclimates mean even greater variability in fertiliser responsiveness: a very steep, dry hill with low soil moisture content won't grow much pasture, while the soil in a less steeply contoured hill holds more moisture and is more productive. However, with variability comes opportunity. Intensive manual soil sampling of hill country farms would need the entire New Zealand army to become full-time soil testers. So Ravensdown sought emerging, world-leading technologies to deliver a solution. They found sophisticated scanning technologies that used hyperspectral sensing (measuring a range of light bands) to capture data remotely. The hyperspectral scanner uses some 2,500 wavebands compared to our digital cameras which use 3 wavebands. The decision was taken to evaluate the technology for assessing the characteristics of soils remotely.

The ambition is to undertake soil testing from the sky. To this end, Ravensdown embarked on a seven-year $10.34 million programme with its investment partner the Ministry for Primary Industries, under its Primary Growth Partnership (PGP). Massey University and AgResearch are the key science providers in the work.

MANAGING FERTILISER USE

The goal is ambitious. Can we accurately, quickly and cheaply gather detailed soil and plant data on hill country farms so we can be much more precise with the types and rate of fertiliser nutrients applied by air? If so, can we produce significantly more from the fertilisers used whilst reducing the impact on the environment? A double benefit.

Fertiliser is one of the top expenditure items for farmers, alongside debt servicing and feed. If farmers can reduce their fertiliser expenditure through greater efficiency, they will be more profitable and have greater choice about where else to invest, be it fencing, riparian planting, regrassing, weed and pest control or even a new woolshed. Better data about the fertility characteristics of their farm will also give farmers the confidence to make decisions about how to best use their land.

ENCOURAGING EARLY RESULTS

Early results are very encouraging from eight research farms geographically covering both the North and South Islands – including Otago, Canterbury, Nelson, Wairarapa, Hawkes Bay, Wanganui, Central North Island and the Waikato. So far, detailed scanning of four of these farms was undertaken from an aircraft equipped with remote sensing equipment, accompanied by intensive on-farm soil and plant measurement. Over 1,000 soil and herbage measurements per farm were taken, compared to a typical 5-10 measurements per farm, building up a detailed picture of soil and plant characteristics.

Terabytes of data have been collected which is now being analysed and the early results look promising. What is being seen, in correlating the remote sensing with the on-farm measurements, is that the data is well correlated and at a very good resolution – down to the level of 1 square metre. This will enable farmers to plan the application of fertiliser in a much more precise manner, instead of the "blanket" top-dressing approach which previously saw some areas over-fertilised and other areas under-fertilised.

ENHANCING AIRCRAFT FOR BETTER TOPDRESSING PRECISION

In the three years since it started, Ravensdown have already delivered on one key aspect ahead of schedule. In two topdressing planes, they can now send an electronic instruction to the plane that ensures fertiliser is automatically applied at the intended rate when the plane is over the target area with a post-application record of the event.

No more do farmers need to be concerned that the fertiliser went on the wrong paddock or even the wrong farm. The next step is to automatically apply fertilisers at different rates within a hill country farm based on enhanced resolution from the scanning results. This is absolutely transformational, a world-first as far as we know, and represents the biggest advancement since topdressing began in the 1950s. When the Co-op speaks to farmers about this, the most common sentiment so far has been 'can you go faster with this project?' Such is the opportunity for enhancing the performance of the hill country farms and farmers' desire to leverage technology to improve.

A GAME CHANGER FOR FARMERS

Hill country research farms in the North and South Island are the pioneers of Ravensdown's Pioneering to Precision programme – a $10.34 million, seven year programme under the Ministry for Primary Industries' Primary Growth Partnership (PGP).

The ability to soil test from the sky and have proof of placement from aerial spreading are the opportunities being presented to eight research farms across the country, with Ben Todhunter at Cleardale Station one of the first to be trying out the technology being developed. He's hoping his Rakaia hill country farm will be able to benefit from the ability to more precisely manage his soil nutrients and fertiliser programme.

"The concept is interesting and I'm keen to help and utilise the science that is being developed," Ben says.

He explains the technology will be key to continuing their conservation work on their hill country farm as well as enabling them to be more effective in growing and converting pasture into a more valuable product.

"I'm most looking forward to better understanding the soil variability of soil fertility across the property, and being able to be more precise with our fertiliser application, improving targeting applications to optimise distribution and improving accuracy away from waterways and conservation areas.

As part of the precision agriculture journey, this is where Ben sees hill country farming going.

"Ravensdown's aerial soil scanning technology is a bit of a step change in nutrient application. It is a part of New Zealand's continuous improvement and tendency to lead in the early adoption of new technology, which will help the economics and profitability for hill country farms.

"I see it becoming a part of the precision ag norm, where flat land farmers will also take up the technology. I'm hoping it will end up within the drone technology so farmers or contractors can operate it themselves in a timelier fashion. It's the type of thing the South Island Farmer of the Year entrants would be in to as they're continually looking around for new things to try."

Michael White, Ravensdown Technical Development Manager, adds that the national network of research farms for Ravensdown's PGP programme are spread over a range of geographical landscapes and climates so that the remote sensing technology can be tested for all conditions.

"In the future, once we've calibrated the sensor we hope to be able to use more affordable sensors with the algorithms that we're developing so it can become a commercial operation.

"The technology, if proven, will be a game changer for hill country farming, especially when accompanied with Ravensdown's specially-modified planes operating computer-controlled hopper doors."

He says that the precision map-driven variable fertiliser placement being developed outside of Ravensdown's PGP programme will bring the remote sensing technology full circle in its goal to deliver more sustainable and productive technology to New Zealand farmers.

"We've been running the aerial spreading technology for nearly two years now and the efficiencies gained from this is already showing its value. Coupling the PGP programme's remote sensing technology that assesses soil fertility from the air with the GPS driven variable rate spreading with proof of placement, is game-changing for our hill country." ■