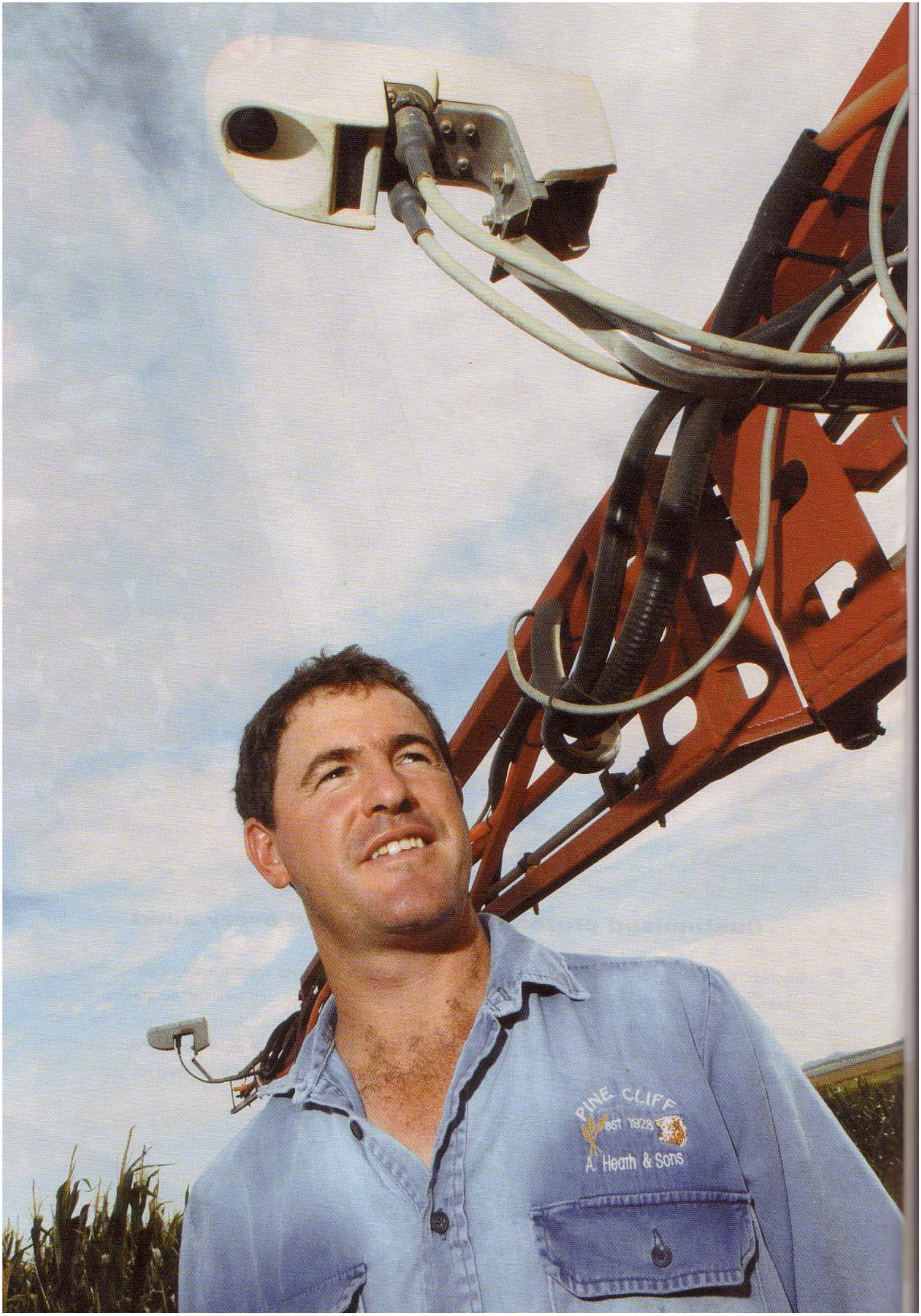
PINE CLIFF
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BY **GRAEME JENNINGS**
JON LAMB COMMUNICATIONS

Sensory perception delivers big benefits

Applying additional nitrogen to reference strips in his cropping paddocks has proved a revelation to one NSW farmer.

Nitrogen-rich reference strips are becoming an integral part of Richard Heath's innovative nitrogen management regime, an approach that is increasingly making use of the latest sensor and precision agriculture technology.

"The concept appeals to me because it is logical and paddock specific, and it seems to work well for us," says Richard, who farms at Curlewis, near Gunnedah, NSW.

Richard, who describes his farming system as on-going opportunity cropping, says using growth in the N-rich strips as a reference point to assess how much in-crop nitrogen to apply has produced net benefits of up to $85/ha in winter cereal crops over the past three years.

Over those three years, observations of growth in the N-rich strips compared to the crop in the rest of the paddock have proved more accurate than soil tests in determining the need for top dressed fertiliser.

"If there is no difference between the strip with luxury N and the rest of the crop it is a good indication the crop is not limited for nitrogen," says Richard.

"The greater the difference the greater the need."

In 2003 and 2004 the recommended rate of nitrogen based on soil test results was 100kg/ha but there was no visual difference between the N-rich strips and the surrounding crops and no yield increase in response to in-crop nitrogen in either year.

Satellite images generated as part of the Grains Research and Development Corporation's SIP09 PA program also failed to distinguish any difference between the strips with "luxury" N levels and the rest of the paddock.

Last season, top dressing nitrogen at rates based on the N-rich test strips rather than soil test results produced a net benefit of $20/ha over normal practice.

The large visual responses to top-dressed N suggested a much greater variation in yield response but the yield differences did not eventuate because of an outbreak of fusarium head blight in the durum crops triggered by mild, wet and cloudy conditions at flowering.

Top-dressing growing-season N is not common on the Liverpool Plains, where most farmers apply all their N fertiliser either before or during planting, usually as anhydrous ammonia or urea.

Opposite: Richard Heath's GreenSeeker RT200 uses six optical sensors spaced evenly along the boom to map crop NDVI.

But Richard, who has been exploring the concept since 2001, is confident that in-crop fertiliser has a place.

In 2001 a trial was conducted by Richard's agronomists, Pursehouse Rural Agribusiness, to compare application of Big N (anhydrous ammonia) ahead of sowing with UAN – a fluid fertiliser – at late tillering.

The crop receiving the late application of nitrogen yielded 400 kg/ha more than the pre-applied crop despite receiving only two thirds as much nitrogen fertiliser and looking "lighter, thinner and generally poorer" throughout the growing season.

That result convinced him to continue exploring the issue of N management and related technologies; a decision reinforced by what he saw during his 2003 Nuffield Scholarship study tour of the US, UK and Canada to look at sensors and N management.

"The growers and researchers I talked with overseas are all heading down the same N-management track of precise management involving strategic

A family business

Richard Heath, his three brothers and their father run a cropping and grazing enterprise on Pine Cliff, their 5,300 ha property located about 30 km south of Gunnedah, at the northern end of the Liverpool Plains in northern NSW.

The brothers are the fourth generation of the Heath family, who have been farming in the Curlewis district for 75 years.

They have 3,300 ha of cropping country and run commercial beef on 2,000 hectares of treed native pasture.

A switch to time controlled (cell) grazing has seen a steady increase in the amount of forage available and the diversity of native forage plants in their pastures.

They also operate a feedlot used to finish the cattle. The brothers have clearly defined roles in the family enterprise.

Richard is cropping manager, one bother runs the cattle enterprise, another is the office manager and the youngest is currently working as a general station hand.

Their father keeps a watching brief over all aspects of the business.

Precision ag: Richard Heath uses yield data to verify and validate management decisions including variety selection, fertiliser decisions, herbicide use and seeding rates.

applications of N fertiliser late in the growing season," Richard says.

"Growers in more marginal areas are most interested because the lower yield potential in most seasons mean they need to keep a close watch on input costs.

"In the brown soil belt of south west Saskatchewan they place a high priority on not over-stimulating early growth to ensure there is adequate water available to fill the grain; which is also a major factor in many regions of the Australian grain belt.

"N cost is a major driver for us because a lot of the N we apply seems to produce early growth that is not reflected in grain yield.

"The key is to maximise nutrient efficiency by monitoring and managing early crop growth through strategic applications of N to achieve the best possible yield."

Based on what he saw overseas and the results from three years' trials on Pine Cliff, Richard believes the use of N-rich strips – an integral part of the US-developed GreenSeeker nitrogen management system – can significantly improve the accuracy of calculations of growing season N requirements.

He is currently assessing the potential of the GreenSeeker system for his farming enterprise after recently taking delivery of Australia's first boom-mounted RT200 GreenSeeker from Crop Optics Australia.

But, while he has had the GreenSeeker machine on Pine Cliff for only a few months, Richard has been using the N-rich strip concept since his return from his Nuffield study tour, working mainly on the basis of visual comparison of each strip and the rest of the paddock, backed up by a borrowed hand-held GreenSeeker unit.

"The sensor reflects what you can see. If you can't see any difference between the strip and the rest of the crop the machine won't show it up. If you can, it will give a reasonably accurate measurement of the difference."

The GreenSeeker system comprises a sensor that uses infra red and near infra red light to determine the nitrogen level in a crop based on its normalised difference vegetative index (NDVI), and a series of algorithms that use the NDVI values of the N-rich strip and the rest of the crop in each paddock to calculate growing season N requirements.

Satellite imagery can also provide NDVI values for crops and the Farm Star technology being marketed in Australia by Terrabyte also comes with algorithm-based recommendations for nitrogen fertiliser applications.

The GreenSeeker calculations are based on an in-crop benchmark of N performance provided by applying "luxury" quantities of N to a representative strip of crop in each paddock.

The growth of the strip and the rest of the paddock are then measured using the sensor, with the difference between the two the starting point for determining how much N to apply.

The operator can select one of several GreenSeeker algorithms developed at Oklahoma State University over the past 20 years or configure his own by inserting data specific to his property and farming system.

The GreenSeeker sensor provides an accurate measurement of the difference between the N-rich strip and the rest of the crop but the assessment can also be made visually, as Richard has been doing for the past three years.

The boom-mounted GreenSeeker RT200 uses six optical sensors spaced evenly along the boom to map crop NDVI.

ahead of a long fallow into a summer crop.

The summer crop is usually sorghum but sunflower or corn are also options, depending on seasonal conditions and prices.

They usually grow feed barley for use in the feed lot where they finish cattle from the grazing enterprise.

Until recently Richard has grown mainly durum wheat, which has been a reliable "winner" due to consistently good yields and returns, but bread wheat is gaining ground.

Not only are bread wheat yields tending to match durum tonnages, possibly because of the move to no-till and other changes to the farming system and possibly because of the better-yielding bread wheat varieties now available, but he is finding he can he can sow bread wheat varieties with resistance to crown rot into durum stubble.

Durum's susceptibility to crown rot means it is not feasible to grow durum on durum.

Richard likes to grow canola, which he values as a break crop, when seasonal conditions are right and prices justify it, and sees a nitrogen benefit from growing faba beans.

He finds using no-till for summer and winter cropping a "much more comfortable system" than the combination of tillage and no-till he was using previously.

In the mixed system paddocks were worked up ahead of winter crops but sorghum was planted – on one-metre row spacings – into wheat stubbles without pre-sowing cultivation.

The next step is a move to a full controlled traffic (CT) system with all cropping machinery, including the header, on a three-metre track width and with compatible operating widths based on a 12-metre module.

The GreenSeeker can map N levels across a paddock and, when combined with GPS and variable rate technology, can vary nitrogen applications "on the go" on the basis of the crop's NDVI.

Richard expects the transition, scheduled to be completed by the end of 2006, will improve crop performance and make the cropping program easier to manage.

For the past few years he has operated with a 24-metre spray boom, an eight metre Kinze precision seeder for summer crops and a 12-metre air seeder for winter crops.

The winter sowing and spraying equipment was on a two-metre wheel base but the header was on a three-metre wheel base.

That limited CT model worked well in summer crops so he decided to adopt CT for winter and summer cropping as the opportunity arose, and a new header they bought last year and a new tractor now on order are the final pieces of the controlled traffic jigsaw.

"Since we were going to buy the machines anyway we decided to specify the same tracking width to gain the advantages of CT, particularly elimination of compaction of the cropping area, " Richard says.

Having the header – the heaviest piece of equipment on the farm – on the same wheel base as the other equipment brings the harvesting operation into line with planting and spraying and opens the way for a true controlled traffic system that will confine all their cropping machinery to three-metre "tram lines".

The new header has a 12-metre front – the previous one had a nine-metre cut – and he still has the 24-metre spray boom and 12-metre air seeder, which he hopes to adapt to sow summer as well as winter crops by fitting vacuum-operated precision seeding units to convert the air seeder fertiliser delivery system into a precision seeding mechanism.

Plant spacing is critical in summer crops and the level of accuracy needed can be achieved only with metered seed delivery and precise seed placement.

Precision ag

Richard, a farmer co-operator in the northern program of the GRDC's SIP09 precision agriculture project, is also exploring the potential of precision agriculture.

The family's first GPS guidance unit was fitted to the spray rig seven years ago.

When the sprayer wasn't in operation the GPS unit was used to lay down "tram tracks" that were followed manually.

Today the tractors and header are fitted with Farm Scan RTK auto-steer system units tracking a "two centimetre" signal

Matching availability with yield potential

Richard Heath's 2003 Nuffield Scholarship tour to study nitrogen management and remote sensing confirmed his belief that there had to be a better way of managing nitrogen nutrition in cereal crops.

Nitrogen fertiliser is a major cost and in 2003 the Liverpool Plains, NSW, farmer was spending about $100/ha to apply an average 100 kg/ha of N per crop no matter what, he says.

The actual rate varied depending on the results of soil tests.

But he felt that approach to N nutrition was "pretty unimaginative" and unsustainable in the longer term.

"Our approach was working in terms of yield, but I felt there had to be better ways, that we weren't being as rigorous with our N management as we were with some other aspects of our enterprise," he says.

Those perceptions were confirmed by what he observed in the UK, the US and Canada, where growers aimed to match N availability with yield potential, with much of the N added in-crop rather than at or ahead of sowing.

"These guys were adding just enough fertiliser to bring the total available N up to what they calculated the yield potential to be."

Richard used the machine – and the algorithm for dryland US corn – for the first time late last year to calculate the nitrogen requirements of several paddocks of corn they grew this summer; an exercise that indicated he should top-dress 30 kg/ha less N than indicated by soil test results.

He has set up a comparison of the two rates by applying alternating strips of no extra N, the GreenSeeker rate and the soil test recommendation rate across the paddock and is looking forward to assessing the impact of the different treatments at harvest.

He is using the same approach in this season's sorghum crops.

The GreenSeeker can map N levels across a paddock and, when combined with GPS and variable rate technology, can vary nitrogen applications "on the go" on the basis of the crop's NDVI.

Richard is using the RT200 to monitor and map the growth of his summer crops over the growing season.

He is in the process of purchasing a WeedSeeker, which uses the same sensor technology as the GreenSeeker to find and target weeds when spraying fallow paddocks.

Summer and winter

Pine Cliff's location at the northern end of the Liverpool Plains means the family has winter and supper cropping opportunities when conditions are right, but in recent years they have been growing more winter crops than summer, partly because of the low prices for sorghum, the major summer grain crop in northern cropping districts.

Winter rainfall on the Liverpool Plains is less reliable than in many southern cropping districts so growers there depend more on stored soil moisture to grow their winter crops and growers in the Gunnedah district traditionally aim to grow two crops in three years using a rotation of wheat, sorghum, wheat with a long fallow – typically from March to May or June the following year – between the sorghum crop and the second wheat crop.

But following a decision to switch to no-till for winter and summer cropping and adopt a controlled traffic (CT) system in their cropping paddocks, Richard is aiming for four crops in five years, which will involve growing more winter crops on "short fallow" – the period between one winter crop and the next, usually January to May or June.

He believes this is achievable because the move to no-till and CT has increased moisture infiltration and retention.

Richard applies basic rotational and "break crop" principles in his farming system but has no set rotation.

Rather, he sees the Pine Cliff cropping program as a recurring cycle of "opportunity cropping", with the opportunities determined by seasonal, paddock and market factors including soil moisture, grain price, seasonal outlook and paddock history.

His current cropping framework runs along the lines of wheat – either durum or bread wheat – followed by faba beans, canola or barley, then back to a wheat

from a ground beacon "base station" on the property.

Richard has been yield mapping for five years and uses the yield data to monitor his performance in almost every area.

He believes a lack of knowledge about how to interpret and use the insights available from yield maps is one of the biggest shortcomings in the approach taken to PA in Australia.

"People focus on vari-rate application but that is a relatively minor issue for me. Yield maps can tell you how effective your management decisions are.

"I use yield data to verify and validate management decisions including variety selection, fertiliser decisions, herbicide use and seeding rates.

"Those decisions can all impact on yield. The key is to look for patterns in yield across a paddock then work out why that pattern is there.

"You can see the effects of the various decisions and treatments reflected in the yield. The yield patterns also add to my knowledge about the potential of each paddock or area within a paddock and can help establish boundaries between different soil types or areas of different elevation within a paddock."

Richard believes PA has much to offer Australian farmers but that its adoption is being limited by a lack of technical support for growers wanting to explore the new technology.

"Lack of support is slowing the uptake of PA technology by Australian farmers," he says.

"There is little understanding of what PA can do, how to take advantage of what the technology offers and in some cases how to operate the equipment itself.

"And there is virtually no support or advice for growers on how to use the information available from yield mapping, remote sensing and all the other inputs available. To capitalise on PA you need to turn the data collected into useful management information, but that is a major challenge, even with consultant support, which is a rare commodity."

Richard obtains PA support through the Opti-Crop agronomic program he accesses through Pursehouse Rural Agribusiness, in Gunnedah.

It provides a template and reference points for participating agronomists, and a network providing access to the latest international developments in agronomy and farm management.

Opti-Crop has a strong precision agriculture element – it's slogan is "more precision, more profit" – and Richard is able to access PA support from a Pursehouse Rural specialist through the agronomist with whom he normally works.

He pays for the Opti-Crop service, which includes soil, tissue and seed germination tests, weed and insect control and support in the area of yield mapping and PA, on a per-hectare basis. ■

■ More information:
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