ON COMBINE NIR ANALYSERS PROVIDE HIGH ROI

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Farmers have often said that if they purchased everything that was going to save them money, they would go bust. The avalanche of new technology that is now promoted to farmers is extremely confusing. Where and how should farmers proceed with new technology often causes decision paralysis.

This paper presents several case studies from Australian and Canadian farmers who have installed a CropScan 3000H On Combine NIR Analyser on their combines. As well, at a recent SPAA (Society for Precision Agriculture Australia) meeting in West Wyalong, NSW, Australia, a young farmer gave an excellent talk about his experience with the 3000H system that he installed in 2016. His insights are also presented below.

Description:

Near Infrared (NIR) analysers are used by the grains and oil seed industry to measure protein, moisture and oil in whole and ground seeds. The price for grains is commonly based on the quality or grade of the seeds which is determined by a range of parameters including protein and oil content. The higher the protein and oil content the more valuable is the grain in most world markets. Other parameters include test weight, screening, falling number, sedimentation, hardness and whether there are any defects, stains or foreign matter in the load. However, NIR only measures protein, oil, moisture and starch in cereals and oil seeds.

On farm grain measurements have been common place in Australia for 20 years. Portable and benchtop NIR analysers are available for farmers so that they can take measurements in the field or as they aggregate their grain into their on-farm silos. Some farmers in the USA and Canada have also taken up NIR anlaysers for use on farm, especially in regions where protein premiums are available. In the last 10 years, On Combine NIR analysers have been developed and trialled. The CropScan 3000H was launched in 2013.

The original benefits identified by customers were the ability to blend grain from the field in order to capture higher protein premiums for wheat and to ensure that barley fitted into the malt grade, i.e., 9.5 to 11.5 percent protein. Likewise oil seeds such as canola attract a premium with oil content above 42 percent in Australia.

The second benefit of using an On Combine NIR analyser lies in the agronomic information that it can provide to farmers and their agronomists. Unless you're a biochemist, you may not be aware that protein is made up of approximately 17 percent Nitrogen and approximately three percent Sulphur by weight. As such, when grains and oil seeds are harvested, they remove Nitrogen and Sulphur from the soil in direct proportion to the protein content.

For example, a tonne of wheat with a protein content of 14 percent, has 23.8kg of Nitrogen and 4.2kg of Sulphur in the seeds. The proportions hold true for corn, soybean, barley, oats canola etc. By combining the protein and yield data from the combine, along with the GPS coordinates, a range of maps can be generated, i.e. protein, yield, nitrogen removal, gross margin and protein/yield correlation. These maps provide agronomists and farmers with insights into the availability and uptake of Nitrogen and Sulphur across the fields.

Potassium and Phosphorous, two other important nutrients for plant, are also taken from the soil in the seeds and plant tissue. However, the amounts removed are proportional primarily to the yield rather than the protein content. Approximately 3kg of Phosphorous and 4.5kg of Potassium are removed for each tonne of grains harvested. Nonetheless, removal maps can be generated for all the nutrients, i.e. Nitrogen, Sulphur, Potassium and Phosphorous.

Over the last two harvests, farmers who have installed an On Combine NIR analyser have elucidated several more advantages that complement the original benefits. These include:

More accurate moisture measurements which allows farmers to strip for longer hours;

Differential harvesting to meet forward contracts based on protein;

Validation of Field Strip Trials;

In field moisture blending to ensure loads do not get rejected at the elevator or silo;

Using Protein Maps to develop simple Variable Rate Nitrogen Fertilisation prescriptions.

Results

The following case studies are presented as examples of how farmers have benefitted immediately from using the CropScan 3000H On Combine Analyser.

CASE STUDY ONE: In field blending

Mark and Jordan Hoskinson farm 8000 hectares at Kikora, NSW. They installed a CropScan 3000H onto their John Deere combine in 2014. In one large wheat field Jordan quickly realized that there was a four to five percent variation in protein across the

field. He started to strip grain from one section of the field where the protein content was up to 15 percent. As the bin filled he would monitor the Bin Average for protein as displayed on the PC. He would monitor the tonnage in the bin and when it reached five tonnes, he then stripped grain from another section where the protein was nine to 11 percent, thereby blending the grain based on protein.

He would monitor the Bin Average for the protein as he filled the bin with the lower protein wheat. When the average reached 13.5 percent, he would go to the field bin and out load the grain. He stripped this field over several days and reported that they trucked every load to the GrainCorp silos at Kikora and had every load accepted as APH1 grade. At that time APH1 was paying US$30 per tonne more than APW grade. The Hoskinsons reflected that in previous years this field had produced a mixture of low and high protein grades. Overall, the ability to blend in the fields across their farm had generated an estimated US$40,000 in higher payments as compared to previous years.

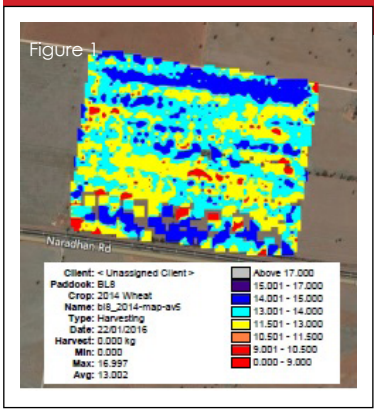


Figure 1 shows the Protein Map for the field mentioned above.

CASE STUDY TWO: On farm segregation and storage

Luke Follett, Pindara, Euston, NSW, grows approximately 6000 tonnes of wheat. He operates two CASE 8130 combines and he installed a CropScan 3000H onto one of his combines in 2014. Luke has six x 1000 tonne silos on farm where he segregates his grain into ASW, APW, AHI and AH2 grades. Luke uses the local AgFarm agent to market his wheat to domestic users.

The CropScan 3000H software calculates the Bin Average for protein for each bin load and then posts the Bin Average to the internet in real-time. The combine operator uses the Bin Average data to segregate the loads into specific field bins based on grade. Trucks are filled from the field bins and taken back to the farm's silo complex. The protein, moisture and weight of every truck load that is stored into each silo is received from the internet and stored in the farm's PC.

Fabian Devereaux, AgFarm, has access to Luke's data by signing into the CropNet web site. He can see what is stored in each silo as shown in Figure 2 and 3. Fabian can then market the grain in each silo based on the running average with confidence that the protein will meet the buyer's requirements.

Luke advised that AgFarm were able to secure an additional US$5 per tonne for 1000 tonnes of wheat from the buyer in guarantee that the average was 12 + percent protein.

He also commented that all truck deliveries passed inspection by the buyer. Since Euston is over 400km from Melbourne, rejected truck loads have in previous years cost him thousands of dollars in penalties and/or returned loads.

Case Study 3: Optimising protein and yield

Matt Hill, Coolinup, WA, operates four x New Holland CR9090 combines fitted with CropScan 3000H On Combine Analyzers installed by Staines Esperance WA. Mr Hill made the following comments regarding the use of the protein data from the CropScan 3000H and other PA inputs to increase productivity across his farms.

"I have been able to combine the yield and EMI maps collected over many years, and now protein maps to develop zones across the farm. We have been able to look closely at the yield response curves to optimise VNR application across the fields. The increase in yield and protein in certain zones across the farm have resulted in a significant return on investment for the PA equipment and services. By going to Variable Nitrogen Rate applications, we have been able to increase the tonnage, to jump to higher protein grades and also to reduce our input costs."

Case Study 4: Agronomic benefits

Steve Larocque, Beyond Agronomy, Alberta, Canada, installed a CropScan 3000H to his JD9750 combine in 2016.

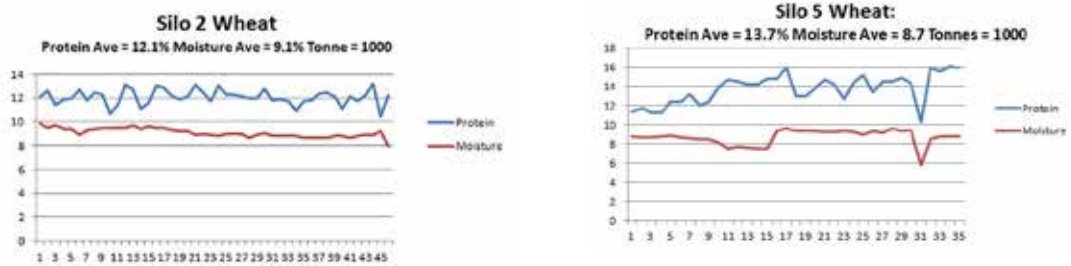
He provided the following comment, "The ability to map protein and combine it with yield mapping is where the magic happens. The sensor gives you an average protein and moisture content for each hopper load. In cereals this may help you segregate high versus low protein wheat or malt barley. I've seen some producers do their own on farm blending using a grain cart. This technology would make it that much easier to blend grain when you know what you have.

"I can see this technology on every combine in the future as it holds great potential to evaluate components of your agronomy program like fertility, fungicides, seeding rates and varieties. It can also be used to segregate grain based on moisture or protein content. It can help avoid heated canola by having accurate moisture readings and improve malt barley selection by blending yourself on farm or storing high protein away from barley that meets spec. I'm really looking forward to sharing my research findings this year using the CropScan 3000H. It's one of the most useful pieces of technology I've purchased in some time" he explained.

Case Study 5: Accurate moisture measurements increase harvest efficiency

Chris Nelson, Strathmore, Alberta, Canada, installed a CropScan 3000H to his New Holland combine in 2017. He knew from his association with Steve Larocque that the CropScan was

Figure 2: Plots of protein and moisture of wheat stored in silos



accurate and reliable but until he used it on his own farm, he did not realise how good it was. Chris farms around 1200 hectares as well as running a local Precision Ag business, Accufarm, in Strathmore. He made two comments about his experience during the 2017 harvest.

Firstly, he found that the NIR moisture measurements were very accurate and this allowed him to strip his fields with more confidence than relying on the combine's in built capacitance moisture meter. As he encountered "tougher country" he would move off to a different area where the moisture was 13 percent or below. This allowed him to continue stripping while his neighbours were stopped. He estimates that he stripped for two to four hours a day longer than his neighbours. This resulted in him finishing harvest about a week earlier.

Secondly, he used the Cr3000H moisture readings to blend the wetter grain with the dryer grain to make sure that the loads were all less than 13 percent moisture.

Chris also found another benefit of using the Cr3000H in his operations. He had a forward contract with Cargill for wheat above 13 percent protein. However 2017 was a low protein year on average.

So, he decided to strip his fields so that each bin load was above 13 percent protein. This meant he had to differentially harvest his fields, but the potential penalties he would incur by failing to deliver the correct grade to Cargill outweighed the logistics difficulties. Once he had stripped the 250 tonne of premium grade wheat and segregated it on farm, he then continued to strip his fields as normal. He continued to segregate any high protein wheat into separate field bins in order to capture some additional protein premiums. However, he commented that many of his neighbours were caught with contracts that they could not fill and had to either buy grain at the higher protein levels or accept the penalties.

Case Study 6: Simple VRF prescriptions based on protein

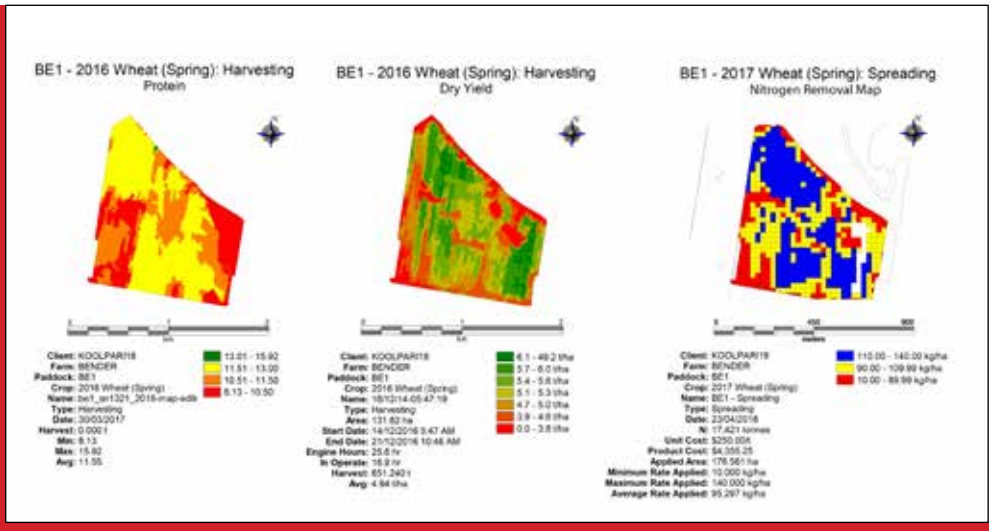
Broden Holland, Grenfeld, NSW, installed a CropScan 3000H onto his new CaseIH 7240 Combine leading up to the 2016 harvest. The CropScan 3000H collected protein, oil and moisture data at approximately every 15-20 metres across their 4500ha farm where they grow wheat and canola. Combining historical yield data and protein data they have been able to develop three zones to apply Urea at three different rates as top dressing. Broden quickly linked low protein response to crop performance, he developed the following simple application strategy:

Urea Application (kg/ha)

Blue Zone:	Protein < 10.5 = 120 kg
Yellow Zone:	Protein 10.6 -11.5 = 100 kg
Red Zone:	Protein 11.5 - 13.0 = 80 kg

By simply converting protein data collected from the CropScan 3000H into a Nitrogen Replacement or Top-Dressing application, he was able to increase the protein levels across the fields. In 2016 the field shown in figure 4 had only .21 hectares that produced H1 grade wheat. Whereas in 2017, 87.9 hectares realised H1 grade. As well, there were 38.8 hectares that realized APW grade in 2016 and H2 grade in 2017. A rough estimate of the increase in crop payments from this field were US$2482, or US$13.60 /ha.

Assessing the yield and protein response post-harvest is critical to assess whether the VRA had a positive or negative outcome. Figure 4 shows the protein and yield response and statistics from the variable rate application of Urea in 2017. The 2017 yield response shows to be 40 percent reduction in the variation in yield across the field as compared with the 2016 yield map.



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Conclusion

The case studies presented above show that the CropScan 3000H On Combine Analyser provides an immediate return on investment for grain farmers across two continents.

There is most likely no other Precision Ag tool that can provide a return in the first year. For example, a yield monitor cannot be used to blend grain on farm or in the field. Controlled Traffic may reduce fuel bills by a small percentage, but it cannot increase revenues. Satellite imagery, soil scans and other diagnostic tools can help develop better harvest strategies for the future, but they do not provide an immediate return on investment.

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