On-the-Go Protein Mapping

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Introduction:

Technology within the agriculturally industry has developed rapidly in the last 10-15 years. Investment into modern and large scale farming will continue as farmers strive to increase yield and profitability. Precision Agriculture will be a key driver in developing technologies to give farmers the data and tools to farm smarter and more efficiently

Near Infrared analysers have been used at bulk handling sites across the country to measure protein, oil and moisture in whole grains for many years. In the past 15 years, farmers across Australia have started using on farm NIR analyser to test their grain prior to delivering into the bulk handling systems or storing into their own on farm storage facilities. In the last few years, these NIR analysers have been adapted to fit on a combine harvester in order to collect protein, oil and moisture data as the grain is stripped.

A local instrument manufacturer, NIR Technology Systems and now Next Instruments, has developed an On Combine Near Infrared Whole Grain Analyser that provides farmers with On-the-Go Protein Maps.

Importance of On-the-Go Protein Maps to Precision Agriculture:

In Australia, the price paid for wheat and barley are graded on the protein content as well as hectolitre weight and % screenings, however in most other countries, crop payments are not graded by protein content. Nonetheless nitrogen based fertilizers are used throughout the world to increase yield and/or protein content. Protein Maps of paddocks are therefore important as a means of implementing Variable Rate Fertilization in order to level out the yield and protein content of the grain across a paddock. The Protein Map combined with a Yield Map, provides an agronomist with a distribution plot of how much Nitrogen has been removed from the soil during harvest. This information can then be used to control the rate of distribution of fertilizer for the next year's planting.

In order to generate Protein Paddock Maps, then an On Combine Analyser using Near Infrared technology is required. An analyser that collects data at regular intervals across the paddock along with GPS coordinates provides a means of displaying real time paddock maps for protein, oil and moisture.

Development of an On-the Go Protein Analyser:

Measuring grain in a header is a very difficult task. The grain needs to be trapped in a sampling device for approximately 3 seconds while a Near Infrared Transmission (NIT) scan is taken. After several years of trialling different sampling devices a robust system has been developed that mounts onto the clean grain elevator. The NIT scan is then used by the instruments software to compute the protein, oil and moisture. Since the NIR analyser requires high precision optics, then it is best to locate the NIR spectrometer in the air conditioned cabin to remove temperature and vibration effects. The NIR spectrometer used in the CropScan 3000H is the same as used in more than 1000

CropScan analysers around the world. The software has been specifically developed to provide operators with real time data as well as posting to data to the Cloud.

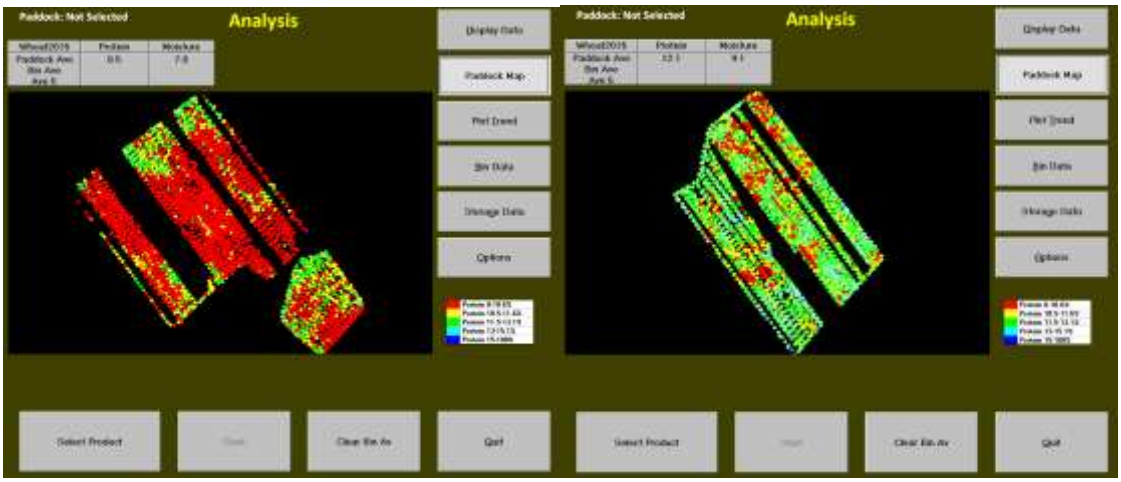
The CropScan 3000H On Combine Analyser has been designed in Australia and for Australian conditions. The system is made up of:

- Remote Sampling Head and Fibre Optic Cable
- NIR Spectrometer
- Touch Screen PC

The Remote Sampling Head is located on the clean grain elevator. As grain flows up the elevator, it drops into the Remote Sampling Head where it is trapped by flaps on the top and bottom of the head. Light from tungsten halogen lamp illuminates the grain and a fibre optic cable on the opposite side, collects the light that passes through the grains. This light travels along the fibre optic cable back to the NIR spectrometer which is located in the cabin. Protein, oil and moisture absorb NIR light at different frequencies and the NIR spectrometer uses a diode array detector and a spectrograph to separate the frequencies of light into the NIR spectrum. The Touch Screen PC takes the NIR spectrum and applies the calibration models that convert the spectral data into measurements for protein, oil and moisture. The Touch Screen PC displays the data in the form of tables and real-time paddock maps.

2013 and 2014 Harvest Data:

In 2013 and 2014 data was collected from several farms in Malley and Wimmera regions. The CropScan 3000H systems are linked back to the farmers PC, smart phones or tablets using CropNet software and web site. CropNet posts the bib by bin results for protein, moisture and oil along with the tonnage to the Cloud. As well the header operator can select a storage option, ie, silo ID, bunker, or off farm storage for each bin load. Farmers can then monitor the grain from their office PC or in the field using a smart phone or tablet. Paddock Maps as shown below are generated both in real-time for the operator to visualise as well as being stored in the Cloud then stored for post harvest processing.



Studies have been done to validate the data against loads delivered to the local bulk handler. The table below shows some comparisons.

Sample	Silo Protein	Silo Moisture	CropScan Protein	CropScan Moisture	Protein Diff	Moisture Diff
1	10.4	12.9	10.4	12.9	0	0
2	10.3	12.5	10.3	12.8	0	-0.3
3	10.5	12.7	10.4	12.8	0.1	-0.1
7	11.7	12.3	12.1	12.8	-0.4	-0.5
8	11.1	12.6	11.3	12.9	-0.2	-0.3
9	12	12.3	12.2	12.5	-0.2	-0.2
12	12.3	12.5	12.2	12.9	0.1	-0.4
13	11.1	11.4	10.6	12.1	0.5	-0.7
				Average Diff	0.0	-0.3
				SEP	0.3	0.2

Conclusion:

The CropScan 3000H provides a means of generating real-time paddock maps for protein, oil and moisture. With combined protein and yield maps, farmers are able to implement Variable Rate Fertilization technology so that paddocks can produce more consistent grain quality and quantity.