UNDERSTANDING PROTEIN VARIABILITY IN CANADIAN FIELDS

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Plants produce seeds in order to propagate themselves, i.e. reproduce themselves. Seeds are composed of carbohydrates, which includes sugars, starches and fibre, as well as proteins, oil and moisture. Proteins are made up of amino acids which contain nitrogen and sulphur. as such measuring protein in seeds provides a measurement of the amount of nitrogen in the seeds. Approximately 17 percent of the proteins is Nitrogen and 3.5 percent Sulphur. for every tonne of seeds stripped from the field, then there is approximately 15 to 50kg of nitrogen and two to seven kg of sulphur removed from the soil.

Understanding the variability of protein across the field relates directly to the amount of nitrogen that was available for the plant's growth and seed development. By measuring the protein and yield in real time as the seeds are stripped in the field, then maps can be generated for protein, yield, nitrogen removal and protein/yield correlation. These maps and the associated data provide the ability to develop more accurate variable rate nitrogen and sulphur fertilization prescription maps.

However, many farmers have never seen data that shows how much variability in protein actually exists within their fields. This paper presents examples from three canadian farms showing protein, yield, nitrogen removal and protein/yield correlation maps.

Description

The CropScan 3000H On Combine Analyser is the new piece of the Precision Agriculture puzzle. Yield Maps have been available for more than 10 years but few farmers use them to develop VRF prescriptions. Yield by itself does not provide a complete understanding of the availability and uptake of Nitrogen and Sulphur by the plants. By combining Yield with Protein, then a more complete picture of how the plant has used the available Nitrogen is provided and thereby a more accurate VFR prescription can be developed.

Steve Larocque, Beyond Agriculture, Calgary, Alberta, has used the CropScan 3000H to measure protein in barley. As a leading agronomist, Steve has pointed out that to achieve the correct Yield in wheat and barley, then the protein in the seeds should be between 11.5 -12.5 percent. his plot of nitrogen application vs. yield and protein, figure 1, shows that the yield figure 1. yield/ protein balance plot reaches an optimum when the protein is

Figure 1

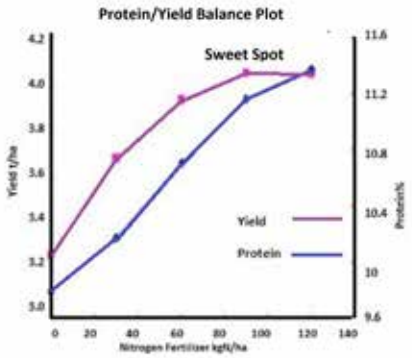


Figure 2

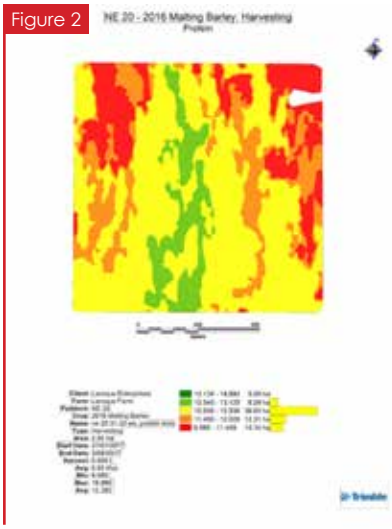


Figure 3

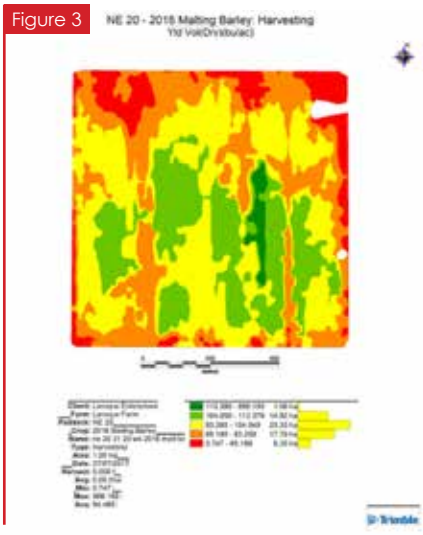


Figure 4

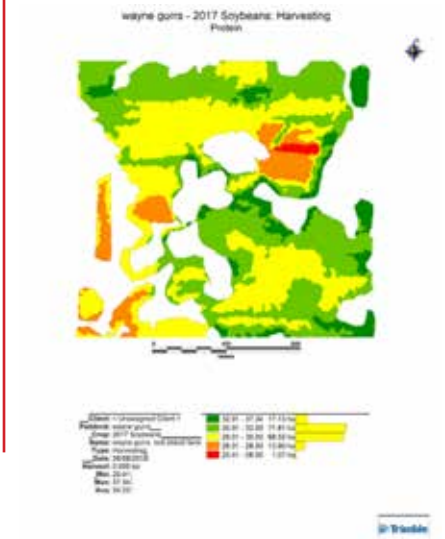


Figure 5

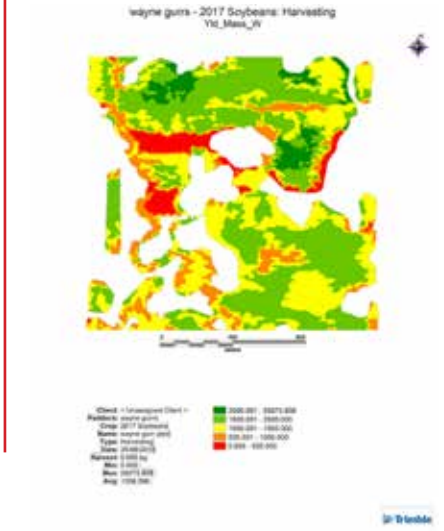


Figure 6

around the 11.5 percent level.

The protein varies across this field from 6.5-13.2 percent, whereas the yield varies from roughly 50 to 112 Bu/Ha. Steve conducts trials for new fertilisers, insecticides etc. In this field he was trialing an injectable N fertiliser down the middle of the field. The green band down the middle of the protein map corresponds to where he applied extra N fertiliser during the flowering and filling stages of the plant development.

The map shows that the areas where the protein map is green and yellow, i.e., > 12%+, correspond to the higher yield areas, green and yellow, in the yield map. Whereas the low protein areas, red, of the protein map correspond to the low yield areas, red and orange, of the yield map.

Adam Gur, Brandon, Manitoba, installed a CropScan 3000H in 2017 onto his Claas Lexion combine. Adam stripped wheat and soybeans. His soybean maps provide examples of how Protein varies in crops other than cereals. Figure 4, 5, 6 and 7 show the Protein, Yield, Protein/Yield Correlation and a VFR prescription for Nitrogen based on the maps.

The Protein varies across this field from 20-37 percent with

an average of 32 percent for loads delivered to the elevator. It is generally expected that soybeans will exhibit an inverse relation between yield and protein, i.e. the dilution theory.

Figure 6, yield/protein correlation map, is a plot of four quadrants for yield and protein. The red and the yellow areas in the correlation plot are where the protein is lowest. Since protein premiums were available for soybeans in 2017, then the Gurs probably did not optimise their income from this field.

However, it is the red areas where the yield was lowest and this would have had the biggest impact on their income for this field. The red areas occupy approximately 12 ha of the 58 ha field. In this area the average yield was 0.5 t/ha less than the average across the whole field. This equates to six tonnes of soybeans at roughly $600/tonne = $3600 lost income.

Without knowing what their fertiliser applications were, it is possible that adding nitrogen in the reproductive stage of the plant's development may have increased the yield in red areas as well as increasing the protein in the yellow areas.

The last example is for a wheat field in Strathmore, Alberta. Chris Nelson has a small farm where he grows wheat and peas. He installed a CropScan 3000H in 2017 and used it to measure protein and moisture in wheat. Figure 8 shows the protein map for two fields on his farm. The Protein varies from 11.5-18 percent, although there is very little that is less than 12.5 percent.

Chris had a contract to supply > 13 percent protein wheat to Richardson Pioneer. He used the CropScan 3000H to firstly strip only wheat above 13 percent to deliver to Richardson Pioneer. Once his contract was completed he stripped the rest of the fields.

In 2017, the region had a lot of rain and the protein levels were lower than normal. Many of his neighbours were unable to meet their forward contracts and paid the penalties. Chris also passed on some more information about how he used the CropScan 3000H to increase his harvest efficiency. He had not realised the Dilution Theory is not evident across the entire field. As the correlation map shows the green areas indicate high protein + high yield. 3000H.

He found that the CropScan matched extremely well to the local elevator who used NIR analysers to test for protein and moisture. He found that having a more accurate moisture measurement allowed him to operate his combine for longer hours because the CropScan was not affected by dew or rain showers like the capacitance moisture meter he had normally used in his combine. He estimated that he could strip for two to four hours extra per day which worked out to be about one day extra harvesting per week. He told us that he was finished harvesting a week before some of his neighbours and he avoided his crop being damaged due to rain storms that came later in the harvest period. He also told us that with a more accurate moisture measurement he could selectively strip the field based on moisture and blend the dry and wet regions to ensure that he did not deliver any out of spec moisture loads to the elevator.

Discussion

The CropScan 3000H has been designed and developed in Australia. As such, Canadian and US farmers are sceptical as to the benefits that can apply to their farms from using an on combine NIR analyser. The three farmers introduced above have provided us with excellent feedback and comments.

Steve Larocque stated in his newsletter, Beyond Agronomy: "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. "

Adam Gur caught up with me at the Brandon Ag Field Days where he and his wife were very excited by their first years' experience with the CropScan 3000H. They were amazed that the system worked so well and proved very reliable and accurate the first year

They said that normally this does not happen with new technology. He later commented in an email, "The distribution in protein as indicated by the maps, comes as a bit of a surprise; in some cases, there appears to be some correlation with yield, in other cases there does not… I hope to get more out of the data this year as we will be more familiar with the product. We plan to run some more complex trials this year on the farm, which we could not do or would not attempt to do without the CropScan."

Lastly Chris Nelson, who is also a manager for Vantage Canada West, a precision ag dealer in Strathmore, commented over lunch that he knew the CropScan was good technology but until he installed it onto his own combine, he did not realise how good it was. Chris's farm is relatively small and he wants to realise the best income he can get from it. He found the system allowed him to blend grain based on protein to ensure that he met his forward contracts and to optimise his payments at the elevator, but as well he increased his harvest efficiency by 20 percent.

Figure 7

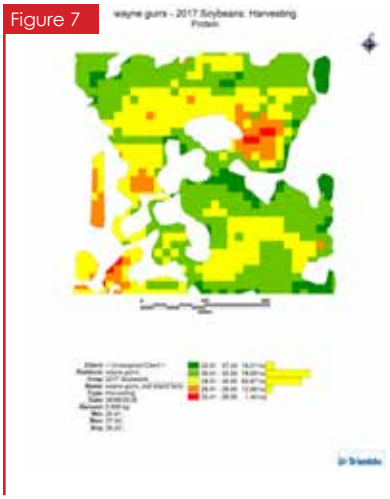
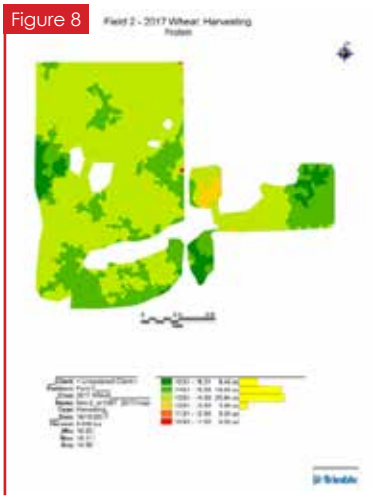


Figure 8



Farmer Business Network published a survey of mid west US farms in 2017. There was a very interesting comment from one farmer that I have heard repeated many times. Basically it states that farmers have only 40 opportunities (harvests) to get their cropping right. As such they need to make the right decisions. Technology is what helps farmers make good decisions.

An international recognised soil scientist, Michael Ayers, Injecta, Adelaide, SA, stated, "The yield map correlates directly to soil performance and the Protein map is a very good proxy for plant performance. The nitrogen data is what makes everything else fit together, i.e., productivity and performance. The on combine protein analyser is a tool of exceptional value whose true value is only just starting to be well enough understood."

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