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Transferring Calibrations Between on Farm Whole Grain NIR Analysers

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On farm analysis of protein, moisture and oil in cereals and oil seeds is quickly being adopted by Australian farmers. The benefits of being able to measure protein and oil in grains and oil seeds are several :

- Optimise crop payments
- Monitor effects of fertilization
- Blend on farm to meet market requirements
- Off farm marketing – sell crop with load by load analysis

However farmers are not NIR spectroscopists and the process of calibrating instruments has to the duty of the supplier. With the potential number of On Farm analyser being in the thousands, then the task of calibrating each instrument would be impossible, let alone the problems encountered with updating calibrations from season to season.

As such, NIR technology Australia has developed a mechanism for ??? their range of Cropscan 2000G NIR analysers so that a single calibration can be transferred from the master instrument to every slave instrument.

Whole grain analysis has been developed over the last 10 years using Near Infrared Transmission through a sample of grain with a pathlength varying from 5-30mm. A continuous spectrum from 800 – 1100nm is the optimal wavelength coverage fro these applications and a grating based spectrophotometer has proven to provide the best means of producing this spectrum. The most important aspect of standardising NIR instruments is to duplicate the spectral information.

The task is to align spectrum from the slave instruments to the master instrument in terms of wavelength positioning and then to adjust the spectral response at each wavelength in order that the slave instruments mimic the master instrument.

The Cropscan 2000G and 2000B Whole Grain Analyser use flat field spectrographs to produce a spectrum from 720 – 1100nm and a silicon photodiode array detector to collect the spectrum at approximately 10nm intervals. The concave holographic gratings used in the flat field spectrographs are produced by a process of photo lithography. As such each grating is an exact replica of the original. To align wavelengths in these instruments, NIR wheat sample scanned on the master and the slave instruments provides three check points in the spectrum to make a more exact alignment. Once the wavelengths are matched then many samples of wheat, approximately 10, exhibiting absorbances from 2 to 4.5 Abu, are scanned on the master and then on each slave. Using a simple linear regression technique, a slope and bias adjustment is made for each pixel of the detector.

This process corrects the spectral response at each wavelength so that the slave instruments produce the same spectra as the master instrument. It is important to use as broad a range of absorbances in the samples so that a good slope and bias estimate can be calculated.

These Slope and Bias (S&B) factors are then downloaded into the slave instruments.

Calibrations developed on the master instrument can then be downloaded onto the slave instruments and perform similarly to the master instrument.

The data shown in this paper illustrates the process of calculating these S&B factors and the transfer of calibrations for wheat, barley and sorghum between several instruments.