Application Note 113: Validation of CropScan 1000G For Protein and Moisture in Wheat and Barley

Introduction:

The Cropscan 1000G has recently undergone a number of hardware and software upgrades. These included:

- new power supply board,
- reduction of the sample cell pathlength from 18 to 16mm,
- inclusion of Z Score Outlier Detection
- improvements to the BarleyA calibration

A validation study was conducted to test the accuracy, precision, reproducibility and temperature stability of these instruments running under the new upgrades.

Procedure:

Four standard experiments were conducted on two CropScan 1000G Analysers.

Test 1: Accuracy

Ten certified reference materials(CRM's) supplied by Graincorp were tested in duplicate on each CropScan 1000G analyser. The results were recorded and compared with the reference results for protein and moisture. The accuracy of each analyser was calculated as the Standard Error of Prediction(SEP), i.e. the standard deviation difference between the reference values for protein and moisture and the predicted results from the CropScan analysers. The expected Accuracy for the CropScan 1000G is as follows:

Wheat	Protein SEP	= 0.3%	Moisture SEP	= 0.25%
Barley	Protein SEP	= 0.35%	Moisture SEP	= 0.25%

Test 2: Precision

The precision of each analyser is the ability to measure the same sample twice. The Standard Deviation of the Differences (SDD) of the duplicate analyses performed in test 1 is used as the determination of Precision of the analysers. The expected Precision for the CropScan 1000G is as follows:

Wheat	Protein SEP	= 0.15%	Moisture SEP	= 0.15%
Barley	Protein SEP	= 0.15%	Moisture SEP	= 0.15%

Test 3: 3-Day Reproducibility

The same ten certified reference materials were tested in duplicate on each CropScan1000G analyser over the next two days. The differences between the average values for protein and moisture over the three days and the values for each day were used to calculate the Standard Deviation of Differences(SDD). This is used as a determination of the Reproducibility of the analysers, or the ability to measure the same samples over three days. The expected Reproducibility for the CropScan 1000G is as follows:

Wheat Protein SEP = 0.2% Moisture SEP = 0.2%

Barley Protein SEP = 0.2% Moisture SEP = 0.2%

Test 4: Temperature Stability

The two CropScan1000G instruments then placed into a 45°C incubator for several hours. The ten certified reference materials were analysed immediately after each instruments was removed from the incubator. The differences the predicted protein and moisture at ambient and 45˚C were calculated. The expected maximum change due to temperature is as follows:

Wheat Protein SEP = 0.4% Moisture SEP = 0.4%

Barley Protein SEP = 0.5% Moisture SEP = 0.5%

Results:

Protein

Test	Instrument S/N	Standard Error Wheat	Standard Error Barley
Accuracy	G004	**0.164**	**0.305**
Accuracy	G015	**0.163**	**0.340**
Precision	G004	**0.045**	**0.152**
Precision	G015	**0.167**	**0.224**
3-Day Rept	G004	**0.088**	**0.161**
3-Day Rept	G015	**0.071**	**0.143**
Temp Stab	G004	**0.230**	**0.228**
Temp Stab	G015	**0.335**	**0.192**

Moisture

Test	Instrument S/N	Standard Error Wheat	Standard Error Barley
Accuracy	G004	**0.079**	**0.062**
Accuracy	G015	**0.266**	**0.123**
Precision	G004	**0.084**	**0.100**
Precision	G015	**0.071**	**0.152**
3-Day Rept	G004	**0.068**	**0.069**
3-Day Rept	G015	**0.041**	**0.047**
Temp Stab	G004	**0.071**	**0.219**
Temp Stab	G015	**0.141**	**0.071**

Discussion:

Test 1: Accuracy

Both analysers passed the Accuracy Tests for Protein and Moisture. As is commonly found, the accuracy for barley is not as good as for wheat. Since Barley grains contain horns they do not pack as well as Wheat grains. This causes larger errors between sub scans.

Test 2: Precision

The results of the Precision Tests were within expectation for both Wheat and Barley for S/N G004 however they were higher for S/N G015. The Barley protein data shows a SDD of .22%. This is considered excessive but on reviewing the data, it was due to one sample that had a 0.4% difference.

Test 3: 3-day Reproducibility

The results of the 3 Day Reproducibility Tests were well within expected ranges for both Wheat and Barley.

Test 4: Temperature Stability

There were large deviations observed between ambient temperature and 45C for protein in both Wheat and Barley. The average temperature affect is:

Wheat Protein = -.035% per Degree C
Barley Protein = -.05% per Degree C

The affects of temperature on Moisture was far less with an average of .0.13% per Degree C.

Conclusion:

Overall the results of this study were very good. The Accuracy and Reproducibility of the CropScan 1000G analysers are similar to the CropScan 1000B and 2000B instruments. The Repeatability of S/N 015 was marginally outside our expectation and the affects of high instrument temperature were excessive. However the temperature of 45C is considered to be at the very high end of the operating conditions and it would be very uncomfortable for some to operate the instrument at these conditions. It does however demonstrate the need to use reference samples to correct for the affects of temperature on a daily basis. The built in Autocalibration software makes such an adjustment by running a reference sample through the instrument.

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