Application Note 150: Three Stability Study of the CropScan Loren 1000G On Farm Analyser

Introduction:

The CropScan Loren 1000G On Farm Analyser is designed to provide farmers and small grain traders with a NIR portable analyser to measure protein and moisture in wheat, barley, oats, triticale, sorghum and oil and moisture in canola. Recent improvements have been made to heat the detector block and thereby reduce the effects of environmental temperature.

This study examines the accuracy and stability of two CropScan Loren 1000Gs using 5 wheat and 5 barley Certified Reference Samples supplied by Graincorp Limited, Narrabri, NSW.

Procedure:

2 x CropScan 1000G analysers were calibrated using Certified Reference Samples with the following values:

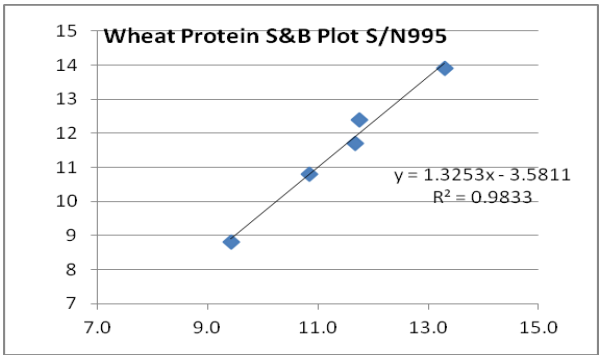
Sample ID	Protein(CM)	Moisture
W1Q3	8.8	11.7
W2Q3	10.8	11
W3Q3	11.7	12.1
W4Q3	12.4	11.1
W5Q3	13.9	11.9
B1Q3	8.9	11.6
B2Q3	9.8	10.7
B3Q3	10.6	10.9
B4Q3	11.4	11.4
B5Q3	12.0	11.2

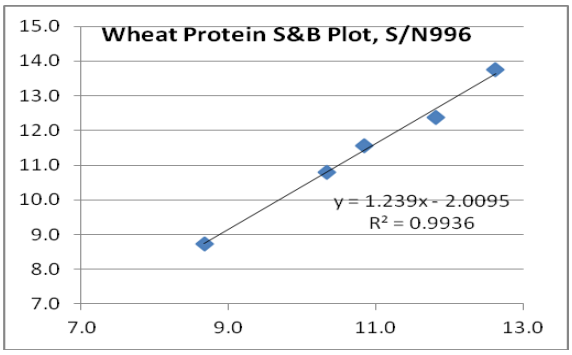
Over three consecutive days, the same 5 wheat and 5 barley samples were analysed on both instruments.

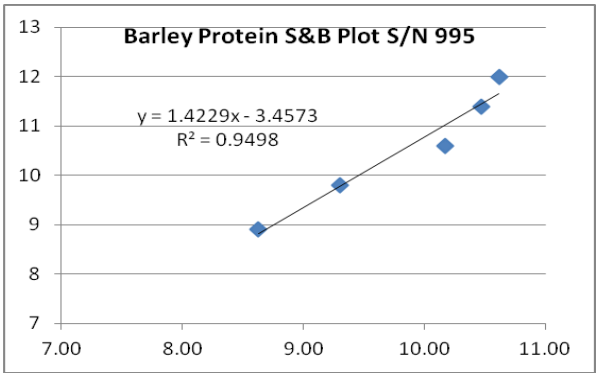
Both instruments were placed into an incubator set at 10C for 2 hours. The instruments were removed from the incubator and the 5 wheat and 5 barley samples were analysed on both instruments. Both instruments were placed into the incubator set at 50C for 2 hours and then the samples were analysed again.

Results:

Figures 1, 2, 3 and 4 show the Protein slope and bias adjustments performed on CropScan 1000G, S/N 995 and S/N 996. The range for moistures in these samples was small and as such only bias adjustments could be made.







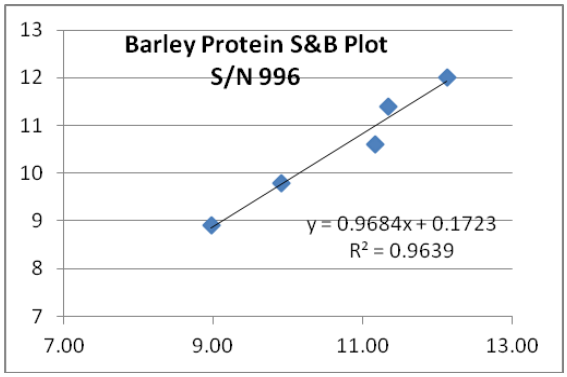


Table 1. shows the 3 days of analyses performed on S/N995. Figures 5, 6, 7 and 8 show the plot of the results over the three days. Note that multiple analyses were performed each day.

Protein

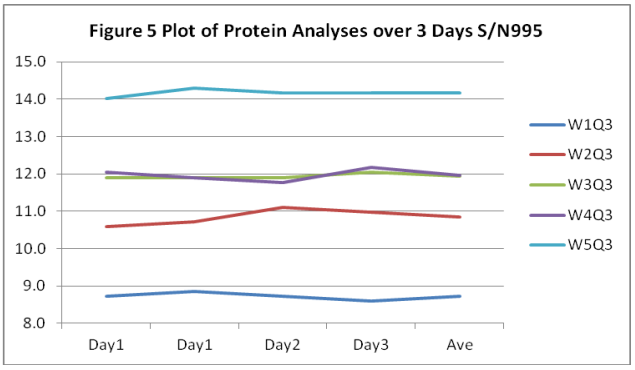
Sample ID	Day1	Day1	Day2	Day3	Ave	SD
W1Q3	8.7	8.9	8.7	8.6	8.7	0.09
W2Q3	10.6	10.7	11.1	11.0	10.8	0.24
W3Q3	11.9	11.9	11.9	12.0	11.9	0.07
W4Q3	12.0	11.9	11.8	12.2	12.0	0.17
W5Q3	14.0	14.3	14.2	14.2	14.2	0.11

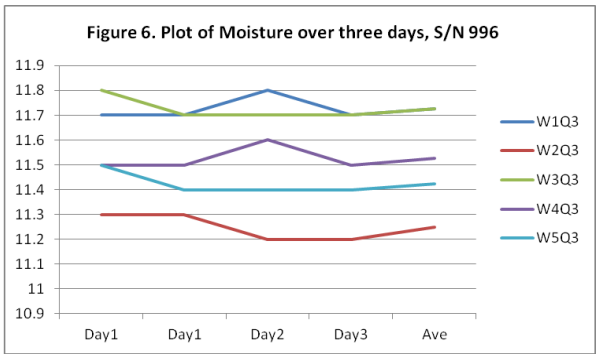
Sample ID	Day1	Day1	Day2	Day2	Day3	Day3	Ave	SD
B1Q3	8.8	8.6	8.6	9.0	9.0	8.6	8.8	0..25
B2Q3	9.7	9.5	9.4	9.4	9.8	10.1	9.7	0.28
B3Q3	11	10.5	11	10.1	10.8	11.3	10.8	0.40
B4Q3	11.5	11.4	11.4	11.3	11.4	11.5	11.4	0.11
B5Q3	11.8	11.6	11.5	11.4	11.8	11.8	11.6	0.21

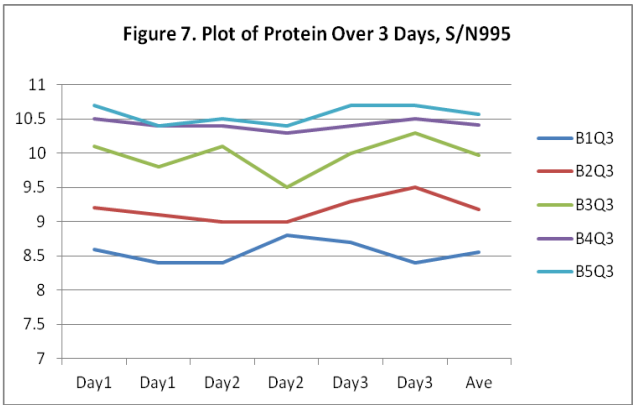
Moisture

Sample ID	Day1	Day1	Day2	Day3	Ave	SD
W1Q3	11.7	11.7	11.8	11.7	11.7	0.05
W2Q3	11.3	11.3	11.2	11.2	11.3	0.06
W3Q3	11.8	11.7	11.7	11.7	11.7	0.05
W4Q3	11.5	11.5	11.6	11.5	11.5	0.05
W5Q3	11.5	11.4	11.4	11.4	11.4	0.05

Sample ID	Day1	Day1	Day2	Day2	Day3	Day3	Ave	SD
B1Q3	11.1	11.5	11.2	11.2	11.3	11.2	11.3	0.14
B2Q3	10.5	10.6	10.6	10.5	10.5	10.5	10.5	0.05
B3Q3	10.9	10.8	10.9	10.8	10.8	10.8	10.8	0.00
B4Q3	11.2	11.3	11.0	11.1	11.0	11.0	11.1	0.12
B5Q3	11.2	11.0	11.0	11.0	11.0	10.9	11.0	0.10







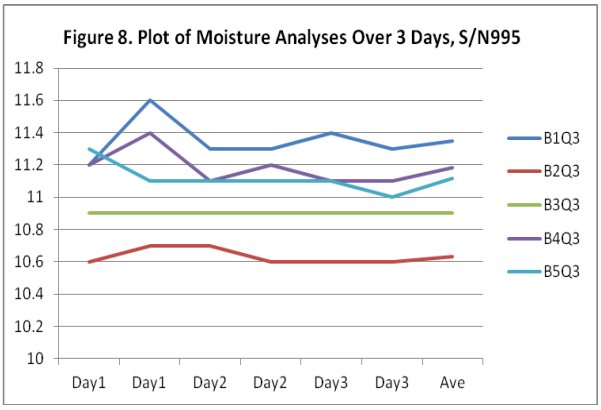


Table 2. shows the 3 days of analyses performed on S/N996. Figures 9, 10, 11 and 12 show the plot of the results over the three days. Note that multiple analyses were performed each day.

Protein

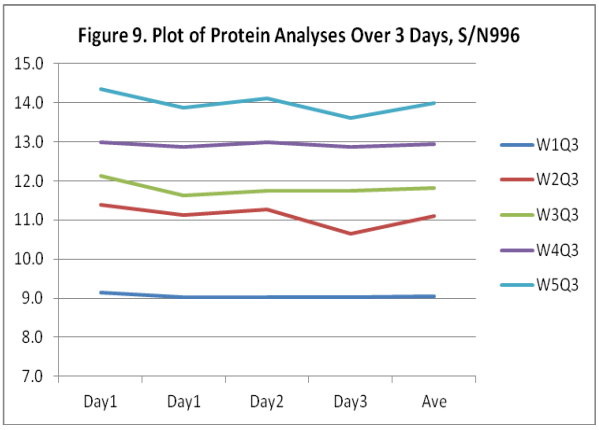
Sample ID	Day1	Day1	Day2	Day3	Ave	SD
W1Q3	9.2	9.0	9.0	9.0	9.1	0.07
W2Q3	11.4	11.1	11.3	10.6	11.1	0.12
W3Q3	12.1	11.6	11.8	11.8	11.8	0.26
W4Q3	13.0	12.9	13.0	12.9	12.9	0.07
W5Q3	14.4	13.9	14.1	13.6	14.0	0.25

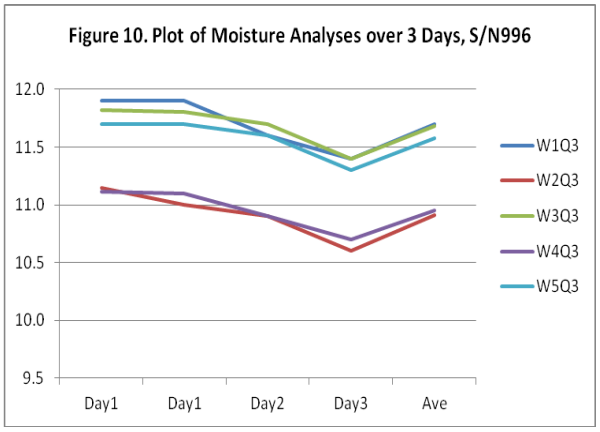
Sample ID	Day1	Day1	Day2	Day2	Day3	Day3	Ave	SD
B1Q3	9.3	9.0	8.9	9.0	8.6	9.0	9.0	0.22
B2Q3	9.6	9.8	10.1	10.3	9.7	9.7	9.9	0.26
B3Q3	11.3	10.8	10.9	10.9	11.0	11.1	11.0	0.20
B4Q3	11.3	10.9	11.3	10.8	11.5	11.1	11.2	0.27
B5Q3	12.1	11.9	12.4	11.4	12.0	11.6	11.9	0.35

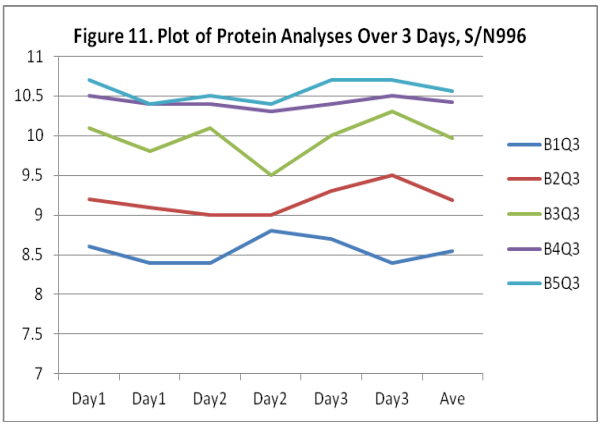
Moisture

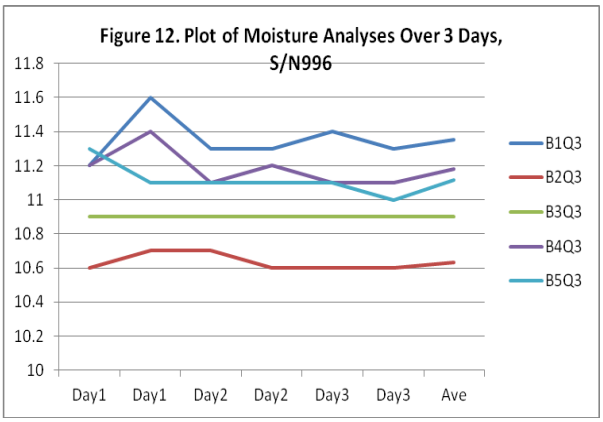
Sample ID	Day1	Day1	Day2	Day3	Ave	SD
W1Q3	11.9	11.9	11.6	11.4	11.7	0.25
W2Q3	11.2	11.0	10.9	10.6	10.9	0.21
W3Q3	11.8	11.8	11.7	11.4	11.7	0.21
W4Q3	11.1	11.1	10.9	10.7	11.0	0.20
W5Q3	11.7	11.7	11.6	11.3	11.6	0.21

Sample ID	Day1	Day1	Day2	Day2	Day3	Day3	Ave	SD
B1Q3	11.6	11.4	11.5	11.5	11.5	11.4	11.5	0.08
B2Q3	10.7	10.6	10.8	11	10.7	11	10.8	0.17
B3Q3	10.1	10.9	11	11	11.1	11	10.9	0.37
B4Q3	11.4	11.3	11.3	11.3	11.5	11.4	11.4	0.08
B5Q3	11	11.1	11.1	11.3	11.1	11.2	11.1	0.10









Instrument Temperature:

Table 3. shows the results of analysing the samples after the instruments have been placed into cold and hot conditions for 2 hours.

S/N995	Cold Inst	Hot Inst	Cold Inst	Hot Inst
Sample ID	Protein	Protein	Moisture	Moisture
W1Q3	9.5	9.8	11.7	11.5
W2Q3	11.0	11.0	11.5	11.1
W3Q3	12.3	11.9	11.8	11.7
W4Q3	12.7	11.5	11.5	11.5
W5Q3	14.4	13.6	11.6	11.4
S/N996	Cold	Hot	Cold	Hot
Sample ID	Protein	Protein	Moisture	Moisture
W1Q3	9.3	8.8	11.8	11.7
W2Q3	11.5	10.4	11.2	11.2
W3Q3	12.0	11.5	11.7	11.7
W4Q3	13.1	12.6	11.2	11.0
W5Q3	14.1	14.2	11.8	11.6
S/N995	Cold	Hot	Cold	Hot
Sample ID	Protein	Protein	Moisture	Moisture
B1Q3	9.1	8.1	11.3	11.2
B2Q3	10	8.8	10.6	10.6
B3Q3	11.4	9.6	11	10.8
B4Q3	10.8	9.8	11.1	11.1
B5Q3	10.9	10.1	11.1	11

S/N996 Sample ID	Cold Protein	Hot Protein	Cold Moisture	Hot Moisture
B1Q3	8.4	9	12	11.6
B2Q3	9.6	9.6	10.9	10.8
B3Q3	11.1	10.9	11.1	11.1
B4Q3	11.3	11.1	10.9	11.4
B5Q3	12.3	11.7	11.2	11.1

Discussion:

According to the NTEP (National Type Evaluation Procedure, USA) for NIR Protein analysers, the standard deviation of the difference over three days should be 0.15% or less. NIR Technology Systems has used this figure as a benchmark for many years. According to the NMI (National Measurement Institute, Australia) N10 protocol, the Maximum Permissible Error (MPE) for stability and temperature should be +/-0.4% for protein in wheat and +/-0.5% for protein in barley.

Table 4 shows that the average SD(Standard Deviation) both instruments over three days.

Wheat	Protein	Moisture	Barley	Protein	Moisture
S/N995	0.14%	0.05%		0.18%	0.08%
S/N996	0.15%	0.21%		0.27%	0.16%

Table 5. shows the differences between the average result for each sample and the individual analyses.

S/N995	Protein	Moisture	S/N996	Protein	Moisture
W1Q3	0.2	0.1		0.1	0.3
W2Q3	0.3	0.1		0.5	0.3
W3Q3	0.1	0.1		0.3	0.3
W4Q3	0.2	0.1		0.1	0.3
W5Q3	0.2	0.1		0.4	0.3
S/N995	Protein	Moisture	S/N996	Protein	Moisture
B1Q3	0.3	0.2		0.4	0.1
B2Q3	0.3	0.1		0.5	0.2
B3Q3	0.5	0.0		0.3	0.8
B4Q3	0.1	0.2		0.4	0.1
B5Q3	0.2	0.2		0.8	0.2

Conclusion:

Although the CropScan Loren 1000G On Farm analyser is not designed with the intention of qualifying for NTEP or NMI certification, the test performed above provide a good means of assessing the performance of the analyser. In both the NTEP and the NMI criteria, the CropScan 1000G would have been deemed acceptable for measuring protein and moisture in wheat, however for barley, only S/N995 would have passed the NMI criteria and may just be acceptable under the NTEP criteria. But S/N996 was shown to be less stable and would have failed the tests.

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