GrainSense

WHITE PAPER

GRAINSENSE DEVICE ACCURACY

White paper
GrainSense device Accuracy

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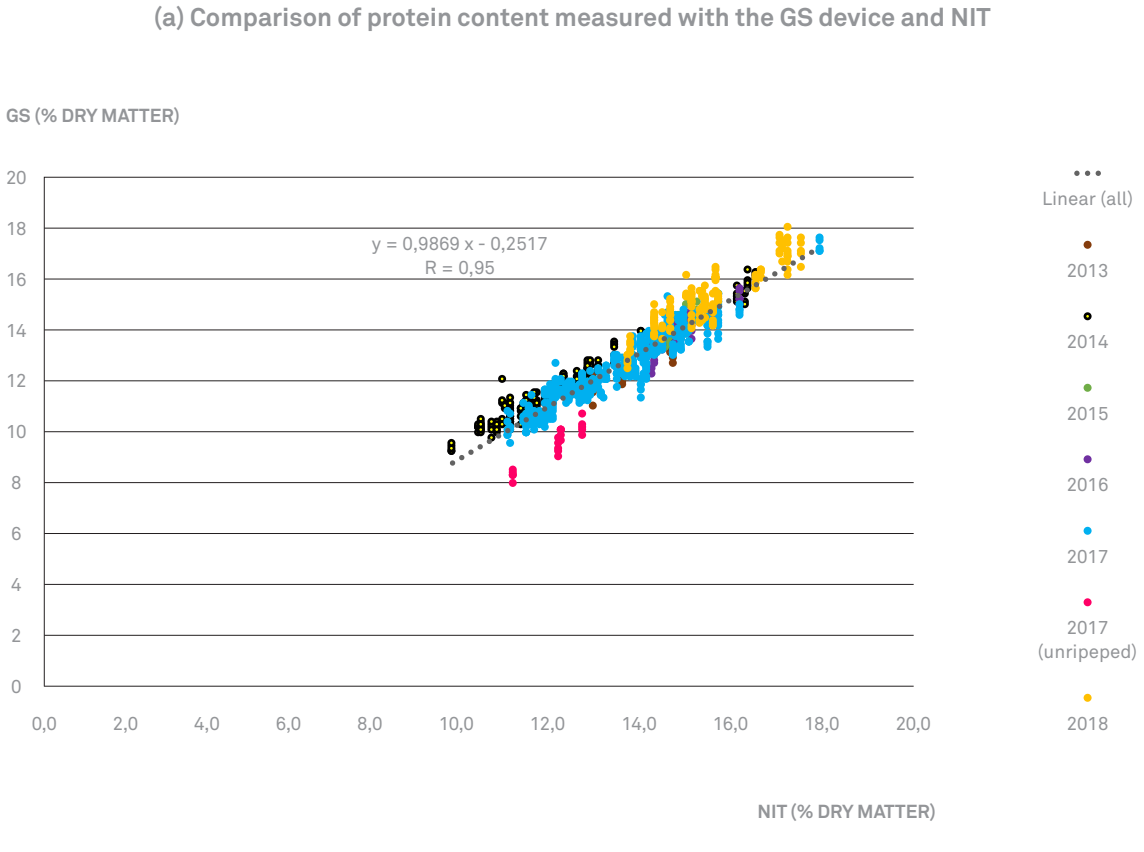
Protein results in line with laboratory NIT analyzers

Accuracy of the GrainSense device comparable to NIT laboratory devices.

Testing 187 wheat samples from 10 commercial and 33 non-commercial varieties collected in Finland during several harvest years, and without performing any offset corrections, correlation coefficients were 0,95 for protein (0,56% STD) and 0,99 for moisture (0,67% STD), see Fig.1.



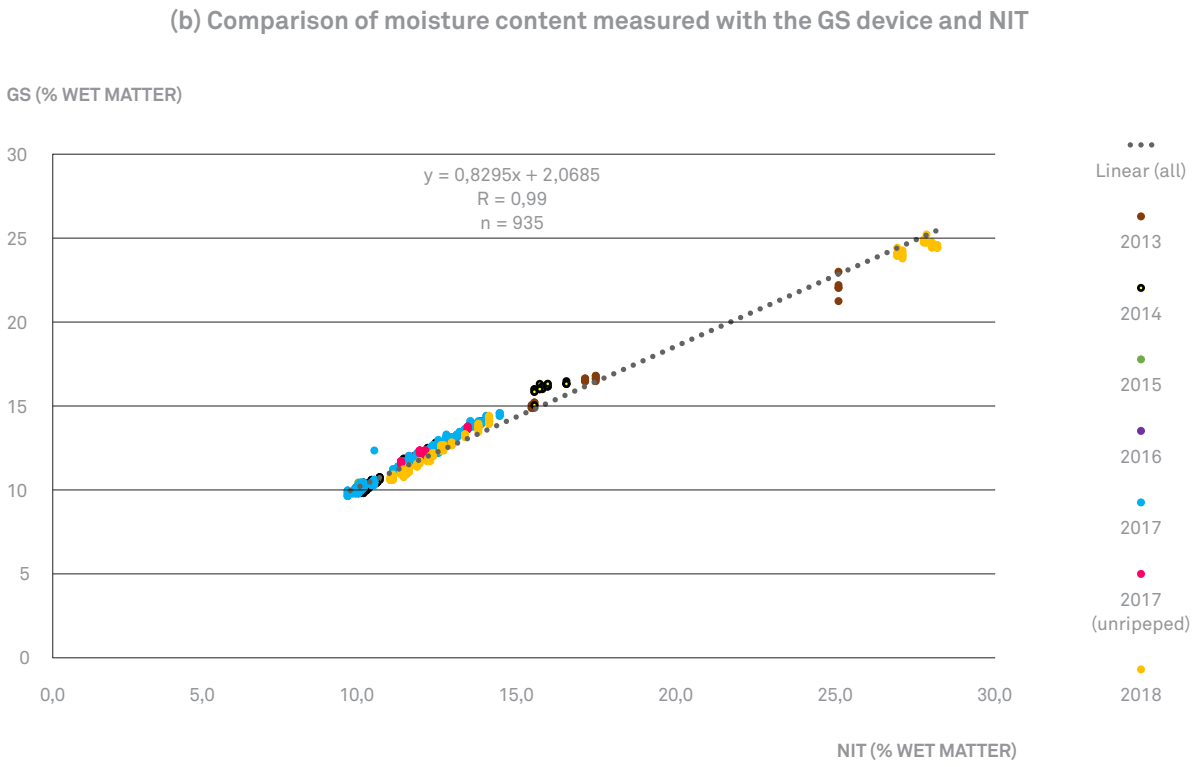


Fig 1: Comparison of (a) protein and (b) moisture results. NIT = average of two measurements. GS = individual measurements (using 60-80 kernels per GS measurement). The data includes 187 grain samples, each sample measured 5 times with GS. The 2017 unripened samples (pink dots) had only around 850 effective thermal sum hours. The high-moisture samples (>20%) were created by adding moisture. No outliers deleted, no offset corrections performed.

In a second test, only the commercial samples of harvest 2018 were measured to explore the need for offset correction (n=120, separate figure not shown). The differences between NIT and GS measurements were:

	PROTEIN (% dry matter)	**MOISTURE** (% wet matter)
Average (GS-NIT)	-0,11	-0,09
STD (GS-NIT)	0,33	0,16

Table 1: Comparison of only the commercial varieties, harvest 2018. First row shows offsets, second row shows the standard errors.

Good repeatability of all four parameters

Repeatability of Grainsense Measurements

The repeatability of the measurements is very good for all four contents: protein, moisture, carbohydrates, and oil. Repeatability was studied by randomly selecting five samples and measuring them ten times in a row. A typical example of the protein and moisture data generated is shown in Fig.2 and summary statistics are shown in Tab.2.

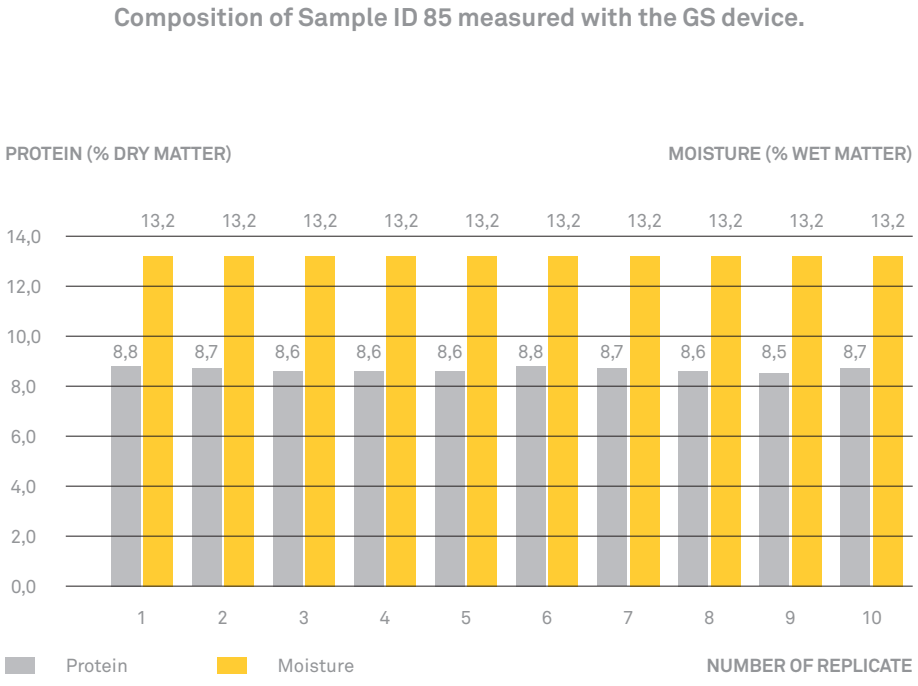


Fig 2: Typical example of a repeatability test: Protein and moisture results of 10 replicate measurements (reloading the same kernels).

	PROTEIN (% dry matter)	**MOISTURE** (% wet matter)
Range	0,22	0,07
STD	0,07	0,03

Table 2: Repeatability results studied on 5 samples, 10 replicates each. Range = Max – Min. Shown are the averages over the 5 samples.

Too large samples sizes affect the results

Loading too many kernels into the GrainSense device has an effect on the results, because the kernels start to touch each other. Testing sample size of around 100 kernels lowered the protein readings (by 0,25% on average) and raised the moisture readings (by 0,12% on average) compared to the recommended sample size (60-80 kernels).

A connected portable device for an accurate measure of the grain quality

Some facts

In Europe, farmers grow more than 300 million tons of grain cereals (mostly wheat and barley) annually, valued at more than €40 billion. In the grain cereals business, the quality of the produce, particularly the protein content, is of paramount importance because it determines for which applications the harvest can be used. However, farmers current lack the possibility to measure the protein content of the grain due to lack of convenient tools that could be used on the farm.

GrainSense system is a portable measurement system for grain quality determination. It is meant to be used especially by farmers alongside their work routines in farms to define the quality of the grain before, at and after the harvest.

"Taking the actual device in use and starting measurements is easy by following the instructions of the Quick Guide booklet"

"The user interface is very clearly organized, and different functions are easy to find."

"It is important to follow the given instructions about how to prepare the kernel sample for the measurement. "

— Liisa Pesonen, Luke

About LUKE

Luke is the Natural Resources Institute of Finland. Luke carried out an independent third party scientific test on the GrainSense device, by evaluating the accuracy and physical functionalities of the device.

Luke tested the GrainSense device using commercial and non-commercial wheat varieties harvested during 2013 to 2018, and compared to a NIT grain analyzer in the Finnish grain network.

Materials and Methods

The GrainSense system was tested by comparing the moisture and protein results of 187 Finnish wheat samples to the results of laboratory NIT measurements (FOSS Infratec 1241 grain analyzer in the national network). The tests were carried out at Luke's laboratory in Jokioinen, Finland, during summer and autumn 2018.

Two sets of data were collected. First, a set of 157 wheat samples from harvests 2014 to 2017 was measured. About 20% of the harvest 2017 samples were not fully ripe. This set consisted mostly of non-commercial varieties grown on test farms, and included both spring and winter wheats. Second, a set of 30 samples from 5 commercial Finnish spring wheat varieties from harvest 2018 were measured. All data were put into Fig 1.

NIT Lab Device : Each sample was measured twice by the lab device, one measurement representing an average value of 10 sub-measurements. The two measurements were averaged.

GrainSense : Five sets of 60-80 kernels each were collected from each sample and measured straight after the NIT measurement. Portions of 80-100 kernels each were also collected and measured, to test the effect of sample size.

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