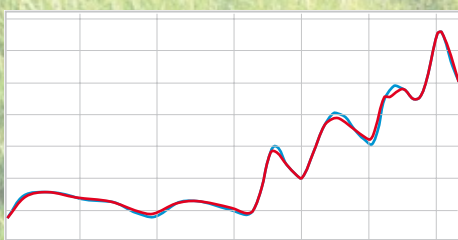
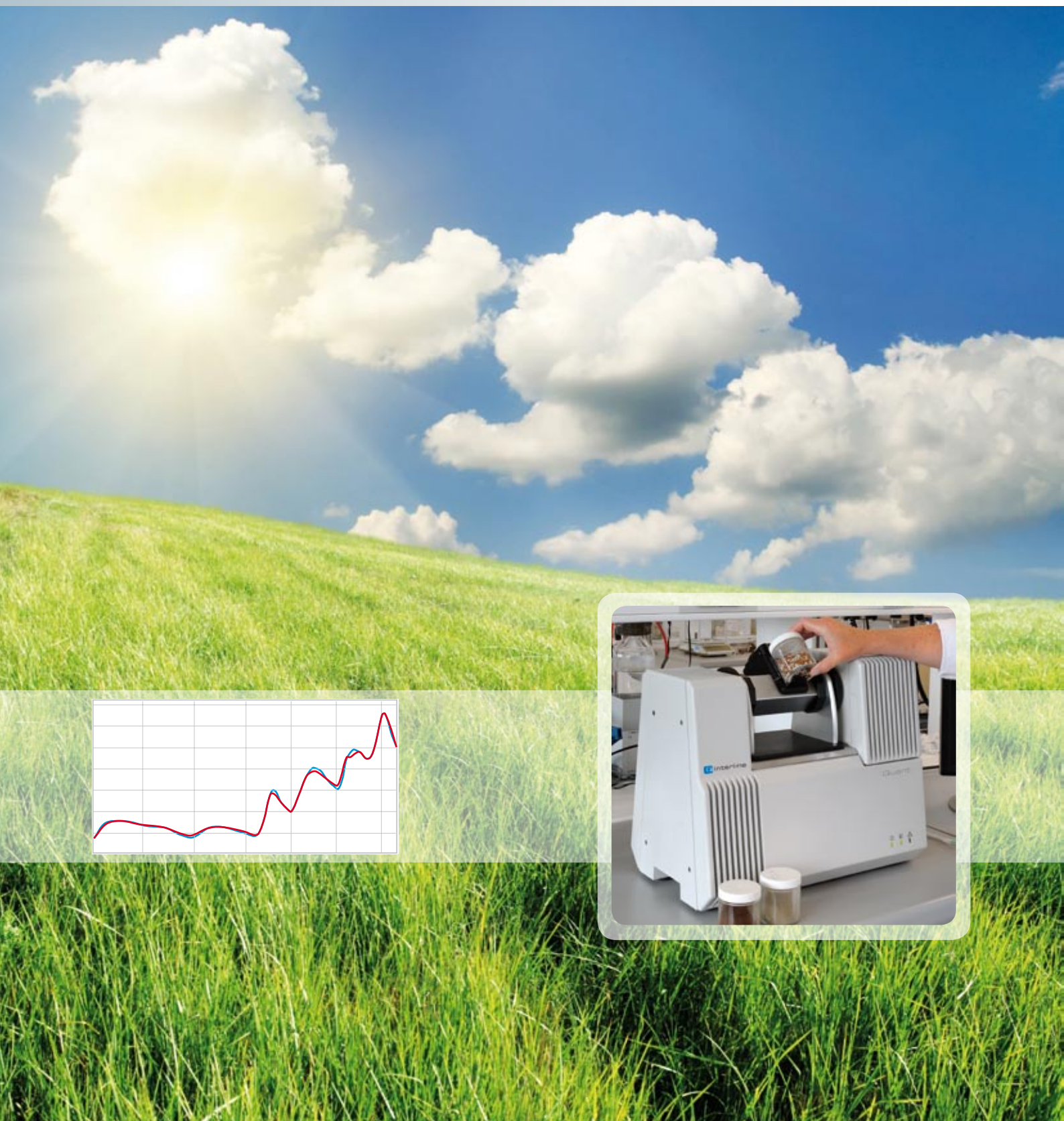


Application Note

Forage



Introduction

Forage - grass and maize silage - is widely used for feeding cows, and it is mandatory to know all the major components and the feeding value of these products. NIR analysers have replaced most of the traditional methods, since they can run a large amount of samples in a short time, either manually or automated. The analysis time per sample is less than one minute.

Analyser: The FT-NIR AgriQuant

The AgriQuant FT-NIR analyser is used for non-destructive analysis of heterogeneous agricultural samples. The pre-treated sample is filled into the lidded glass bottle and placed on the accessory. To ensure consistency and analysis of a large amount of the sample, the sample is mixed during analysis. The sample can be kept due to the sealed bottle.

The AgriQuant is powered by the latest ABB Bomem FT-NIR technology and measures the entire spectrum of the sample, i.e. in the range 14000-3800 cm⁻¹ (700-2600 nm). It generates a large amount of high-quality spectral data, which makes it possible to precisely determine multiple components.

With no scheduled maintenance for five years, the AgriQuant is practically maintenance-free. It is equipped with parts with a long lifetime. For instance, the laser and NIR source have an expected lifetime of ten years.

AgriQuant is operated with the InfraQuant software, which makes it easy for everybody to work with analyses. Two clicks with the mouse is enough to make the analysis. Among the features is a wizard that guides the operator through the program, spectra are displayed right away, and sample information and trends can be reviewed easily.

Calibration

The AgriQuant is calibrated against certified methods for the different components.

The NIR region contains both combination and overtone information. The most sensitive bands are those derived from the O-H, N-H and C-H stretch regions. Different pre-processing has been used for the different components, typically mean centring and manual base line correction - sometimes 2nd derivative (Savitsky-Golay). A Partial Least Squares (PLS) model was developed based on the analytical and spectral data.

Calibration Performances, Example

60 samples of dried maize and 70 samples of dried grass have been used for the modelling. The material has been ground and put into glass bottles. Table 1 shows the performance of the calibrations developed for all the components with chemical reference analysis available. Repeatability test has been done with a sample of grass measured 5 times.

Grass	Range %	NIR SECV	Repeatability
Protein	6-27	0.69	0.07
Fibre	17-38	0.89	0.08
In Vitro	52-84	1.84	0.54
Sugar	0.2-18.3	0.90	0.12
NDF	29-68	1.54	0.12
ADF	21-40	1.12	0.16
pH	4-5.4	0.094	0.022
Lactic Acid	1.2-13.8	0.62	0.072
Acetic Acid	0.9-3.5	0.27	0.078
Ammonium No.	0.06-0.3	0.030	0.003
Maize	Range %	NIR SECV	Repeatability
Protein	6-10	0.37	0.08
Fibre	14-34	0.73	0.07
In Vitro	62-80	1.52	0.48
Starch	1-38	1.28	0.11
NDF	30-64	1.38	0.16
ADF	18-31	0.76	0.15
pH	3.7-4.1	0.072	0.018
Lactic Acid	2.7-7.2	0.43	0.064
Acetic Acid	1-4.4	0.26	0.077
Ammonium No.	0-0.11	0.008	0.003

Table 1: Performance of the dried forage calibrations

Conclusion

The AgriQuant FT-NIR analyser is designed for analysing forage and feed. The bottled sample is mixed during analysis to see a large amount of the sample, which will lead to reliable and stable results. The results are obtained in less than one minute on multiple components. This eliminates individual analysis on each constituent and saves manpower, training and time. The analysis can be automated using transport belt, bar code reader or radio frequency tagging.