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Testing for Life

CHECKING FEED VALUE WITH NIRS

WHITEPAPER

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Introduction

Pick the method that works best for your specific goal

The better you understand what's in your silage or fresh grass, the smarter your feeding strategy can be. Analysis provides insight - and increasingly that insight is delivered through Near Infrared Spectroscopy (NIRS), as a quick and cost-effective alternative to classical analysis. But not all NIRS methods are the same. In this white paper, we explain the key differences between handheld NIR scanners and laboratory based NIR setups, helping you choose the method that best suits your purpose.

NIRS on the rise

Analysis by laboratory based NIRS has been has been commonly used in agriculture for several decades, and has proven its value in determining feed composition and value. More recently, mobile, or handheld, NIRS devices have become available, enabling feed analysis to be done directly on the farm. These new technologies are opening up the possibility of having answers on-demand and without delay.
Both approaches - on-farm and in-lab analysis - have their pros and cons. Understanding the differences is crucial when choosing which method suits your purpose best.

Content

1 What is NIRS?

NIRS involves analysing a sample using light reflection. Light is directed towards the sample, and the reflected light is used to create a “fingerprint.” This process takes place in the near-infrared region of the light spectrum (hence, NIRS). The technique produces a sample-specific spectrum that captures the unique properties of the sample. This spectrum is considered the sample’s fingerprint, as no two spectra are identical.

However, the spectral fingerprints generated by NIRS are difficult to interpret. The strength of NIRS comes from combining NIR spectra and wet chemistry data in calibration models to ascertain the scanned sample’s composition.
NIRS analyses is a method that provides information about the composition of a wide range of organic materials, including silages and fresh roughages. The technique is also widely used in medicine, the food industry, and environmental research.

Pinpoint your analytical goal
There are several reasons to evaluate the feed value of silage or fresh grass with NIRS:

- To check whether your current feeding approach is on track
- To optimise or adjust the ration

Different NIRS machines provide varying levels of insight. Factors such as sensor quality, database quality, modeling expertise, material properties, and sample type all affect measurement accuracy. Generally, the higher the quality of the device, the higher the cost of analysis. Therefore, understanding your analytical goal is essential for selecting the most suitable method.

NIRS can determine a range of nutritional parameters, including dry matter, protein, sugars, and fibres, because each organic compound absorbs a different amount of light.

2 Complicating factors

One complicating factor in NIRS analysis is the presence of water. Water absorbs a substantial portion of the light, which can significantly distort the spectral data. The higher the water content of a sample, the less light is reflected to the detector. As a result, wet samples appear very dark, making it difficult to extract reliable information about their composition. Therefore, high-quality instrumentation is required to obtain meaningful results from wet samples. This is particularly important for samples with a dry matter content below approximately 300 g/kg.

Equally important is the proper grinding and mixing of the sample. Imagine a jar filled with red, yellow, green, and blue M&M candies. If you take a sample from top to bottom, you'll get an even distribution - about 25% of each colour. But if you only scan the top layer, you might end up with 100% blue. Drying and grinding ensure the sample is homogeneous, allowing for accurate, representative results.

That's why drying, grinding, and mixing are standard steps in laboratory protocols for in-lab NIRS analysis. However, if you would like to analyse samples on the farm, then it is not possible to prepare the sample in this way. As a result, the technology must be capable of coping with these complicating factors.

The type of sensor matters
Another important thing to know is that not all NIRS sensors are the same. The range of light wavelengths a sensor can measure affects how well it can measure different nutrients. Handheld NIRS devices used on farms usually measure light in a narrower range (around 900 to 1,700 nm), while lab equipment can measure a wider range - up to 2,500 nm or more.

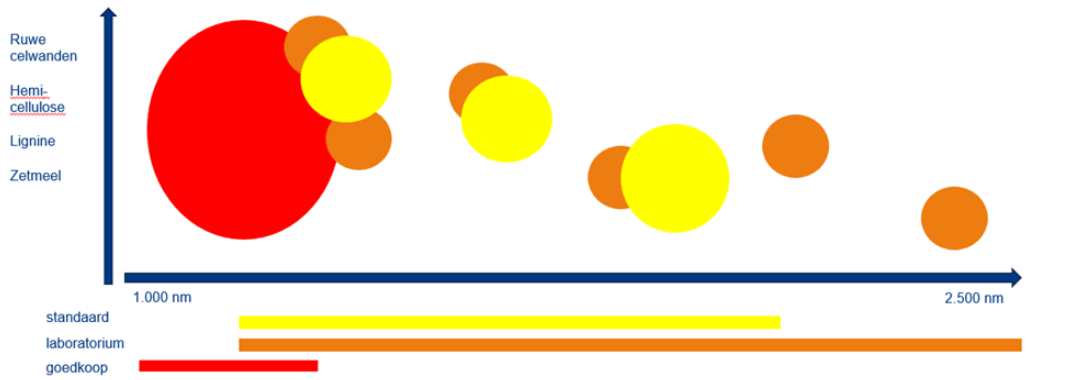
NIRS sensors work by picking up tiny vibrations in the organic molecules of the feed. These vibrations show up differently depending on the type of nutrient or compound present.

The light is divided into several regions, each with different qualities:

1. **750 - 1,000 nm:** This light goes deeper into the sample, but the information is messy and harder to read.
2. **1,000 - 1,400 nm:** This part gives better information about what's in the feed.
3. **1,400 - 1,900 nm:** This range gives similar information, but it's clearer and stronger.
4. **1,900 - 2,500 nm:** This range adds even more useful details to the full picture.

So, a device that covers both the 1,400–1,900 nm range and the 1,900–2,500 nm range can give more accurate results—*if* the sensor is of good quality.

Think of it like this: scanning at lower wavelengths is like looking at a closed grocery bag—you get an idea of what's inside, but cannot see the fine details. Scanning at higher wavelengths is like opening the bag and checking every item. The more of the light range the scanner can “see,” the better it can tell what’s really in your silage or feed.



The broader the wavelength range of a NIRS device, the more detailed and accurate the analysis. Handheld scanners, like the Trinamix device(yellow) distinguish between fibre, protein, and starch. The Eurofins Agro in-lab device (orange) goes further, differentiating between fibre types and protein structures. Low-range sensors (red) can only confirm the presence of certain nutrients in feed.

3 The role of reference sets

Organic compounds can exhibit remarkably similar fingerprints in their NIR spectra. Even a trained eye cannot determine the composition of a sample by simply looking at the spectra. To extract meaningful information, a database representing the types of samples to be analyzed is required to translate the spectral data into useful values. This database consists of NIR spectra, from relevant samples, combined with corresponding reference data.

Eurofins Agro has generated a reference database through laboratory procedures that determine key parameters such as protein, fibre, and others. These reference sets are continuously updated in the lab, to keep the application up to date.

In addition to the database, the algorithm (a statistical model) that converts the spectral data into meaningful value must also account for the water which is available in fresh samples, as opposed to lab prepared samples. To handle the additional variable, a large number of samples are needed in the database to reach a sufficient accuracy. The Eurofins Agro NIRS system uses an enormous database to ensure the desired level of accuracy and reliability.

Finally, the database must evolve to reflect changes in forage, such as new plant varieties or silaging methods. Building a new reference set is time-consuming and costly. If a sample falls outside the scope of the reference set, the model will struggle to predict feed quality accurately. This is why Eurofins Agro updates it's NIRS database regularly throughout the year. This way we are always up to date.

NIRS in focus

NIRS stands for Near-Infrared Spectroscopy. It works by directing near-infrared light (wavelengths between roughly 700 and 2,500 nanometres) onto a sample. Some of the light is absorbed; the rest is reflected. The pattern of absorption and reflection depends on the molecules present - especially those with hydrogen-based bonds like -OH, -NH, and -CH groups.

These measurements are then interpreted by a calibration model built from a database, consisting of sample spectra and the accompanying wet-chemical analysis.

4 Choose the right NIRS method for your farm’s need

To get the best results with NIRS, it’s all about choosing the method that fits your needs. Handheld scanners offer convenience and quick results, while lab-based setups provide more detailed and accurate analysis. Both have their advantages but knowing what you're aiming for will help you pick the right one.

Measurement accuracy

When using handheld NIRS devices it’s important to consider the loss in accuracy compared to standard in-lab NIRS analysis. Taking the lab as a reference point for accuracy (e.g. 1), the following comparison can be made:

- A well-calibrated handheld NIRS device typically shows an accuracy between 1.5 to 2 times lower than that of a laboratory NIRS analysis.
- A less advanced handheld device - with a narrower spectral range and a less comprehensive database - may have an accuracy that is 2 to 3 times lower than lab analysis.

About Eurofins Agro Testing

Eurofins Agro has a network of agricultural laboratories across Europe. Established in 1927 and headquartered in Wageningen, the Netherlands, Eurofins Agro focuses on soil, crop, water, compost, and manure analysis. By providing innovative test results and tailored guidelines, Eurofins Agro helps farmers optimise crop quality, manage resources efficiently, and close yield gaps.

Embracing a systems approach, Eurofins Agro analyses the interrelationships within the agri-food system to improve productivity, quality, and sustainability. Its research and innovation hub, located in Wageningen, drives advances in analytical techniques, supporting food security, environmental sustainability, and compliance with global standards. Eurofins Agro leads the way in providing the tools necessary for sustainable, productive and profitable agricultural practices.

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